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IMPACT ASSESSMENT REPORT

Accompanying the documents

Proposal for a

DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Directive 2003/87/EC and Decision (EU) 2015/1814 as regards driving competitiveness and cost-effective decarbonisation

REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Directive 2003/87/EC as regards revised benchmark values for the heat and fuel benchmarks period from 2026 to 2030

REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Regulation (EU) 2015/757 and Regulation (EU) 2023/1805 to simplify and streamline monitoring, reporting and verification and to align with revisions of the EU Emissions Trading System

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ANNEX 15: EVALUATION REPORT

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

GLOSSARY

Term or acronym	Meaning or definition
BECCS	Bioenergy with carbon capture and storage
CCfD	Carbon contract for difference
CCS	Carbon Capture and Storage: a set of technologies aimed at capturing, transporting, and permanently storing CO2
CCUS	Carbon capture, utilisation, and storage
CBAM	Carbon Border Adjustment Mechanism
CDR	Carbon Dioxide Removal
CHP	Combined Heat and Power: a combined heat and power unit is an installation producing both electrical energy and heat
CO_2e	Carbon dioxide-equivalent: a measure used to compare quantities of different greenhouse gases in a common unit based on their global warming potential over a given period
CRCF	Carbon Removals and Carbon Farming framework, established under Regulation (EU/2024/3012)
CSFC	Cross-sectoral correction factor: a factor by which free allocation of emission allowances is reduced uniformly across all industry sectors, if the demand for free allocation exceeds the total amount of available free allowances
DACCS	Direct Air Capture with Carbon Storage
E-fuels	Liquid fuels produced based on hydrogen obtained from electricity via electrolysis.
EEA	European Economic Area
EIB	European Investment Bank

ESR	Effort Sharing Regulation
ETS Directive	Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC
EU ETS	European Union Emissions Trading System covering stationary installations, aviation and maritime transport
ETS2	Emissions Trading System covering Buildings, Road Transport and Additional Sectors in accordance with Chapter IVa of the ETS Directive
EUA	European Union Allowance: the tradable unit under the EU ETS, giving the holder the right to emit one tonne of CO_2e
GDP	Gross Domestic Product
GEM-E3	General Equilibrium Model for Energy-Economy-Environment interactions
GHG	Greenhouse gas
GT	Gross Tonnage
ICC	Indirect carbon cost
IF	Innovation Fund
IMO	International Maritime Organization
JRC	Joint Research Centre of the European Commission
JRC-GEM-E3	Joint Research Centre variant of the GEM-E3 model
LDC	Least developed countries

LRF	Linear Reduction Factor: a factor by which the ETS cap is reduced yearly
MS / MS EU	Member State(s) of the European Union
MSR	Market stability reserve
$MtCO_2$	Million tonnes of CO_2
MW	Megawatt
NECP	National Energy and Climate Plan
NIMs	National implementation measures under Article 11 ETS Directive
NZF	Net-Zero Framework
OPC	Open Public Consultation
PRIMES	Price-Induced Market Equilibrium System model
PRIMES-TREMOVE	Integrated transport component of PRIMES model
SAF	Sustainable Aviation Fuel
SME	Small and medium-sized enterprise
SWD	Staff working document
TNAC	Total number of allowances in circulation

1 INTRODUCTION: PURPOSE AND SCOPE OF THE EVALUATION

1.1 Overview of the EU ETS

1.1.1 How the EU ETS functions

The EU ETS is a classic "cap & trade" system. It achieves its environmental goal by definition – the aggregate emissions of many covered entities cannot exceed an absolute ceiling of (annual) emissions without breaking the rules of the system. The main difference to "command & control" systems is that the individual participant in the system does not get an individual (legally binding) target for their emissions, and thereby implicitly the amount of required emission reductions. Instead, the overall target must be achieved jointly by all participants. The distribution of efforts among participants (who reduces emissions and by how much) is determined through a market interaction based on the various emitters' marginal abatement costs. This gives companies the flexibility to cut their emissions in the most cost-effective way.

Compliance with the system is achieved by surrendering units of "rights to emit". In the EU ETS they are called "EU allowances", or EUAs, with a value equivalent to the emission of one metric tonne CO_2e. These rights can be freely traded. Hence each actor (in the EU ETS they are operators of stationary installations, shipping companies and aircraft operators[1]) can decide whether to emit a certain amount of greenhouse gases (GHGs) and cover them with allowances, or whether to reduce their emissions so that they will have to purchase fewer allowances or is even able to sell allowances in case of a surplus.

Since economically rational actors tend to optimise their profits, either by reducing their costs or by increasing their product prices (if the latter is possible), the following foreseeable effects are at the heart of the ETS:

(i) Operators will try to reduce their emissions to bring down their costs. This can be done either by making the production per unit of product less GHG intensive, or by reducing the production level for that GHG intensive good. The latter will be incentivised if their consumers find ways of using less of that GHG intensive good, either by making more efficient use of that good, or by completely substituting it.

(ii) The consumer in turn also sees an incentive for such changes, because it will ideally be an economically rational actor, who wants to avoid the increased costs brought along by the price of GHG emissions.

Several production processes have "indirect" embedded emissions, referring to the emissions that occur upstream. The most common example is the indirect emissions embedded in the electricity consumed during the production of industrial goods. These production processes can also incur indirect carbon cost, since the carbon price paid by the direct emitter (e.g. a power plant) is passed on to the electricity bill of the consumer (e.g. an industrial installation).

As this illustrates, in an optimally functioning ETS virtually all possibilities for emission reductions are driven by the CO_2 price:

- producing the same goods more GHG efficiently,

[1] In addition to the traditional EU ETS covering large industrial installations and aviation, the 2023 Directive introduces a new emissions trading system (EU ETS 2) for emissions from fuels used in buildings and road transport. This significantly broadens the scope of carbon pricing in the EU. Starting in 2024, the EU ETS also covers emissions from maritime transport. These additional sectors are not part of this evaluation given that they have only recently become part of the system.

- producing a smaller quantity of those GHG intensive goods, as the demand may decline (induced by behavioural change of the end users or replaced by imported goods, that may cause carbon leakage), or
- producing other – less GHG intensive – goods.

1.1.2 How to implement the EU ETS

It is important to note that some practical issues must be solved for putting in place a successful cap & trade system such as the EU ETS. Those elements have been regulated by the ETS Directive and secondary legislation, and are therefore of particular interest for this evaluation and further improvement of the EU ETS:

- A robust system for monitoring emissions and reporting (M&R) emissions to the competent authority is the core of any market-based measure. The M&R system is accompanied by requirements to have the emissions verified by an independent and competent third party ("the verifier"), who in turn should be under some form of legal control (usually accomplished by accreditation). Accreditation and Verification (A&V) rules are therefore also required. M&R and A&V rules are collectively referred to as the Monitoring, Reporting, Verification and Accreditation (MRVA) system. Effective enforcement options (penalties) will also be essential.
- For efficiency reasons allowances exist in a purely electronic form. All allowance transactions, including issuance, transfers, surrender, and cancellation, are recorded in the ETS Union Registry.
- At least one allocation system is required, so that market participants can receive the allowances that they need for compliance. In the EU ETS, auctioning was established as the default method of allocation of allowances from Phase III onwards. Detailed rules were established to ensure that auctions take place in an open, transparent, harmonised and non-discriminatory manner. However, free allocation is still granted to address the risk of carbon leakage. To make this allocation fair, EU-wide rules (based on ex-ante benchmarks) have been put in place.
- As from January 2018, emission allowances are classified as financial instruments by the revised Directive on Markets in Financial Instruments (MiFID2).[2] This classification constitutes an important element in safeguarding the carbon market from market abuse and other types of market misconduct regulated under the Market Abuse Regulation (MAR). Anti-money laundering safeguards are extended to all segments of the carbon market.

1.1.3 The EU ETS and its legislative history

The EU ETS is currently in its fourth phase of implementation. It has undergone a series of significant reforms, primarily due to changes in the level of ambition, but also in response to the key lessons learnt from challenging and often unanticipated problems.

In **Phase I (2005-2007)**, most allowances were allocated for free with each Member State developing a National Plan[3]. Phase I was primarily used for testing price formation in the carbon market and to establish the infrastructure necessary for monitoring, reporting and verification (MRV). The cap during this pilot phase was based on estimates, due to insufficient data the emissions of installations. Therefore, the total allocation of allowances exceeded

[2] Directive - 2014/65 - EN - MIFID II - EUR-Lex

[3] National allocation plans - European Commission (europa.eu)

emissions in Phase I, and this led to a collapse in the carbon price in 2007 to zero (as these allowances could not be banked for use in Phase II).

Phase II (2008 – 2012) expanded the scope in terms of covered greenhouse gases (GHGs), sector (aviation) and countries, and lowered the cap on allowances with respect to 2005. Moreover, Phase II reduced the number of free allowances to around 90%.

Phase III (2013-2020) introduced a single EU-wide cap instead of the previous system of national caps; it prioritised auctioning as the main allocation method; it harmonised allocation rules; and it included additional sectors and GHGs.

The **Market Stability Reserve (MSR)** was introduced with Decision (EU) 2015/1814[4] and began operating in 2019 with the purpose of addressing the surplus of allowances that have been building up the ETS market since 2009 and ensuring resilience against market shocks through a flexible supply of allowances. The supply is controlled by absorbing or reducing the number of allowances in the reserve, which reduces or increases the total number of allowances in circulation (TNAC) available in the market.

Phase IV (2021-2030), through the revised 2018 Directive, established a more ambitious linear reduction factor for GHG emissions, which was increased from 1.74% to 2.2% per from 2021, to achieve a 43% reduction in GHG emissions in the ETS sectors by 2030, compared to 2005 levels. New rules for free allocation and provisions for carbon leakage were also established.

- The provision of free allocation for sectors deemed at risk of carbon leakage was revised to be more targeted and effective.
- The benchmarks applied for the free allocation were revised to be more ambitious
- An Innovation Fund to provide financial support for projects in the areas of renewable energy sources and carbon capture and storage, as well as a Modernisation Fund for the modernisation of energy systems in lower-income Member States, were also established.
- The ambition of the ETS was enhanced further in a revision to the ETS Directive in 2023 that increased the ETS reduction target to 62% below 2005 levels, together with other changes to support the increased ambition.

1.1.4 The EU ETS evaluation and review proposal of 2015

In October 2014,the European Council agreed on the 2030 policy framework for climate and energy. In this framework, the European Council endorsed a binding EU target of an at least 40% domestic reduction in greenhouse gas emissions by 2030 compared to 1990 levels.

The framework established that a well-functioning, reformed EU ETS with an instrument to stabilise the market in line with the Commission's proposal will be the main European instrument to achieve this target and set out a framework of measures in the system. The Commission was invited to implement this framework in concrete policy measures as soon as possible by a revision of the ETS Directive.[5]

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[4] Decision (EU) 2015/1814 of the European Parliament and of the Council of 6 October 2015 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and amending Directive 2003/87/EC

[5] European Council (23 and 24 October 2014). Conclusions on 2030 Climate and Energy Policy Framework (europa.eu)

An evaluation of the ETS Directive[6] was carried out in the first quarter of 2015, which provided inputs and supported the review of the ETS Directive. In July 2015, the European Commission proposed a reform of the EU ETS for the 2021-2030 period, following the guidance set by the October 2014 European Council meeting. After its adoption by Council and Parliament, the revised Directive (EU) 2018/410[7] entered into force on 8 April 2018 and set the framework for the fourth trading period (phase) from 2021 to 2030, in line with the EU's 2030 climate and energy framework.

The Directive was further revised in 2023 under the "Fit for 55" package of legislative proposals, in view to achieve climate neutrality in the EU by 2050, including the intermediate target of at least 55% net GHG emissions reductions by 2030. The current evaluation focuses on the ETS Directive in its version after the 2018 review to evaluate the situation before and after the implementation of the new rules of the fourth phase. The 2023 revision is not included in the current evaluation, as there isn't sufficient data for the assessment (minimum of 3 years-worth of data required by the EU Better Regulation Guidelines[8]).

Regarding the MSR, the evaluation focuses on changes following the establishment of the policy instrument in Decision (EU) 2015/1814. The key provisions and subsequent implementing measures of relevance are highlighted for every design element of the ETS within this evaluation report. The rationale for the interventions across different design elements of the ETS are then outlined in detail before the evaluation responds to the specific questions set in the corresponding evaluation matrix (provided in Appendix III).

1.2 Scope

The scope of this evaluation is focused on the ETS Directive in its version after the 2018 review, as outlined in the 2015 impact assessment. It addresses for the most part the changes that have been introduced for Phase IV of the EU ETS. The evaluation of the individual ETS components, in addition to the relevant provisions in the ETS Directive, includes also the various implementing or delegated acts adopted following the 2018 review of the ETS Directive that are providing the detailed rules (see Appendix III for each individual ETS component evaluated).)

The key aim of this evaluation is to provide an evidence-based assessment of the extent to which the EU ETS:

- Is *effective* in meeting its objectives and delivering the expected results.
- Is *efficient*, in terms of cost-effectiveness and proportionality of costs versus benefits.
- Is *relevant*, in terms of responding to needs.
- Is *coherent* internally and with other EU interventions and international obligations.
- Has *EU added value* compared to action by Member States alone.

As part of the REFIT programme, this evaluation should also assess the potential for simplification and burden reduction, particularly as part of the *efficiency* analysis.

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6 EVALUATION OF THE EU ETS DIRECTIVE Carried out within the project "Support for the Review of the EU Emissions Trading System", EU ETS Directive Evaluation 2015

7 Directive (EU) 2018/410 of the European Parliament and of the Council of 14 March 2018 amending Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments, and Decision (EU) 2015/1814 (europa.eu)

8 Better regulation: guidelines and toolbox (europa.eu)

The interventions assessed as part of this evaluation include the overall EU ETS[9] and the Market Stability Reserve. In addition, the following ETS components that support the implementation of the overall system are evaluated individually, mainly in relation to their effectiveness and efficiency, with the detailed findings presented in Appendix III:

- Provision of free allocation to address the risk of carbon leakage.
- Monitoring, Reporting, Verification, and Accreditation (MRVA).
- Monitoring, Reporting, Verification system for maritime (MRV maritime).
- Auctioning.
- Union Registry.

The Innovation Fund and the Modernisation Fund, established by the 2018 review of the ETS Directive, are evaluated separately[10].

Where results from the analysis in Appendix III are relevant for answering evaluation questions for the EU ETS as a whole, reference is made here to the more detailed sections, instead of repeating those findings. The relevance and EU added value are evaluated only at the aggregate level.

This evaluation is based on a literature review, stakeholder interviews and own analysis. However, no specific economic modelling was carried out for this report, but it refers to the ex post economic modelling and econometric analysis available within the existing literature. For additional details on the methodology, see Appendix II.

2 WHAT WAS THE EXPECTED OUTCOME OF THE INTERVENTION?

2.1 EU ETS

2.1.1 Point of comparison for the EU ETS

As mentioned, in July 2015, the European Commission proposed a reform of the EU ETS for the 2021-2030 period, accompanied by an impact assessment[11]. That proposal led to the revised EU ETS 2018 Directive[12], which entered into force on 8 April 2018 and set the framework for the fourth trading period (phase) from 2021 to 2030, in line with the EU's 2030 climate and energy framework.

The key element of the revised Directive was a more ambitious linear reduction factor for GHG emissions. The proposal determined that to achieve the EU's target to reduce GHG emissions by at least 40% domestically by 2030, the sectors covered by the EU ETS would need to reduce their emissions by 43% by 2030, compared to 2005 levels.

To achieve this target, the linear reduction factor was increased from 1.74% to 2.2% per year from 2021.

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9 Criteria of coherence is assessed only for the EU ETS in general, while the other criteria are assessed also for the specific components.

10 Evaluation of the Innovation Fund's operation (SWD(2026) 199) and Evaluation on the operating rules of the Modernisation Fund (SWD(2026) 197)

11 SWD (2015) 135 final, Impact Assessment accompanying the Proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC to enhance cost-effective emission reductions and low carbon investments

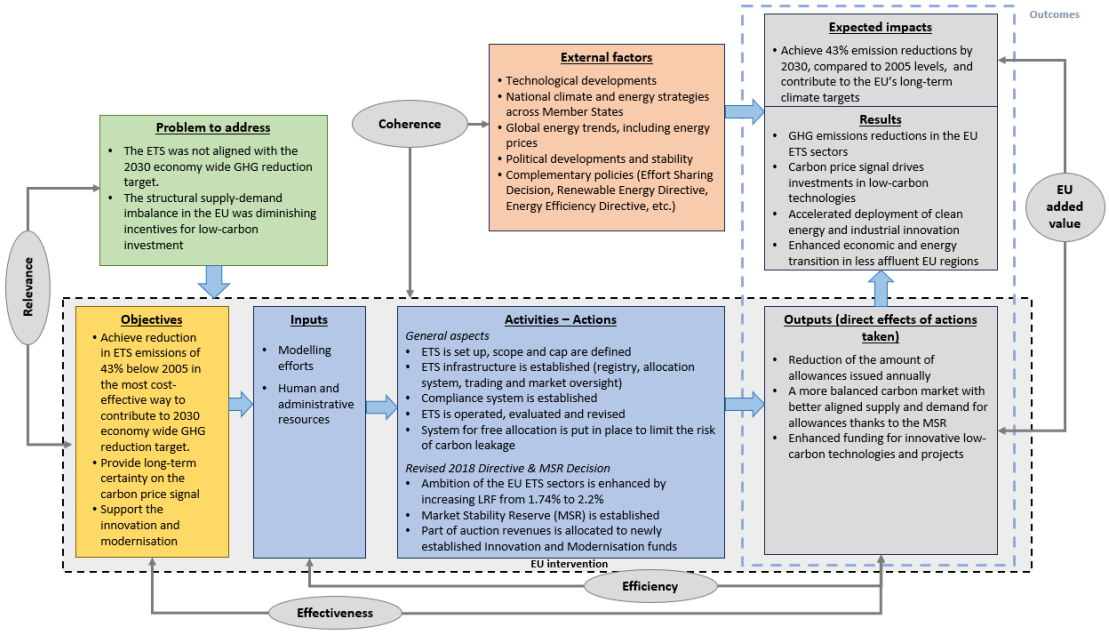
12 DIRECTIVE (EU) 2018/410 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 14 March 2018 amending Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments, and Decision (EU) 2015/1814

The auctioning of allowances remained the general rule in Phase IV, with the share of allowances to be auctioned set at 57%, i.e. the same as in Phase III.

2.1.2 Description of the intervention and its objectives for the EU ETS as a whole

Figure 1 provides an overview of the intervention logic for the EU ETS overall. The policy intervention to be evaluated refers to the operation of the EU ETS in general and in relation to key overarching changes following the revision to the ETS Directive in 2018. The extent to which the EU ETS as a whole has delivered the expected outcomes outlined in the intervention logic below will be the subject of the evaluation. Each element of the intervention logic diagram is discussed further in the following subsections.

Figure 1: Intervention logic (EU ETS)



Source: Own illustration

2.1.2.1 Problem to address

The main problems to address for the EU ETS overall include the fact that:

- The ETS was not aligned with the 2030 economy wide GHG reduction target.
- There remained a structural supply-demand imbalance in the EU ETS, which was one of several factors[13] contributing to a low carbon price signal and therefore reducing the incentives for low-carbon investments This point is addressed in greater detail in Section 2.2.2 on the intervention logic for the MSR.

2.1.2.2 Objectives

Following the previous evaluation in 2015, three specific objectives for the EU ETS overall were outlined in a proposal for amending Directive 2003/87/EC to enhance emission reductions and low carbon investments:[14]

[13] Other factors including weak or no complementary policies, lower general political importance of climate policies leading to less confidence in the market.

[14] EUR-Lex - 52015PC0337 - EN - EUR-Lex

- *Specific objective 1*: “Revise the ETS Directive in a manner to ensure emissions in the EU ETS are reduced by 43% below 2005 levels by 2030.” In so doing, this ensures that the EU ETS contributes to the EU's climate objectives in the most cost-effective manner.
- *Specific objective 2*: “Promote low-carbon innovation and establish, for industrial sectors, appropriate provisions to address the potential risk of carbon leakage in the absence of comparable climate policy measures in other major economies.” This includes more targeted rules on free allocation that are discussed in more detailed in the intervention logic for carbon leakage (refer to Appendix III, Section 8.3)
- *Specific objective 3*: “Implement further ETS-related aspects of the 2030 climate and energy policy framework.” The system should support innovation and the modernisation of energy systems and industrial processes, thereby contributing to the transition towards a low-carbon economy.

2.1.2.3 Actions

Actions to support the functioning and strengthening of the EU ETS can be grouped into general system aspects and those introduced by the policy intervention.

2.1.2.3.1 General aspects

- The EU ETS is established, with its scope and emissions cap defined to set the framework for emissions trading.
- A supporting infrastructure is in place, including the registry, allocation system, trading mechanisms, and market oversight arrangements.
- A compliance system is implemented to ensure that regulated entities meet their obligations through monitoring, reporting, and verification of emissions.
- The system is operated, evaluated, and revised regularly to improve effectiveness and respond to evolving circumstances.
- A system of free allocation is in place to mitigate the risk of carbon leakage.

2.1.2.3.2 Specific aspects under the revised 2018 Directive & MSR Decision

- The ambition of the EU ETS is increased by raising the linear reduction factor (LRF) from 1.74% to 2.2%, thereby accelerating the annual reduction in the emissions cap.
- The Market Stability Reserve (MSR) began operating in 2019 with the purpose of improving the stability and resilience of the carbon market by addressing the structural imbalance between supply and demand of allowances.
- A share of auction revenues is allocated to the newly established Innovation Fund and Modernisation Fund to support the deployment of innovative low-carbon technologies and the modernisation of energy systems in lower-income Member States.

2.1.2.4 Inputs

The inputs identified as necessary for the policy intervention include:

- Modelling efforts to estimate the LRF level for the ETS cap as well as the key design parameters for the operation of the MSR.
- Human and administrative resources dedicated to monitoring, management and administration of the Innovation and Modernisation funds.

2.1.2.5 Output

The outputs as a direct consequence of policy intervention include:

- An increased pace of reduction in the annual volume of allowances issued, in line with the increased LRF.
- A more balanced and resilient carbon market, with improved alignment between the supply and demand of allowances through the functioning of the MSR.
- Increased financial support for the development and deployment of innovative low-carbon technologies and projects, enabled by the Innovation Fund and the Modernisation Fund.

2.1.2.6 Results

Following the outputs from the policy intervention it is expected that this will lead to the following results:

- A sustained reduction in GHG emissions from sectors covered by the EU ETS.
- A more robust and predictable carbon price signal that encourages investments in low-carbon technologies.
- Accelerated deployment of clean energy solutions and industrial innovation, supported by targeted funding mechanisms, facilitated by the Innovation Fund.
- Enhanced economic and energy transition in less affluent EU regions, facilitated by the Modernisation Fund.

2.1.2.7 Expected Impacts

Because of the results from the policy intervention, it is expected that the following impacts will occur:

- Achievement of a 43% reduction in GHG emissions by 2030 in sectors covered by the EU ETS, compared to 2005 levels.
- Significant contribution to the EU's long-term climate objectives.

2.1.2.8 External factors

External factors that may impact the expected impact of the policy intervention include:

- Technological developments that can accelerate or delay the availability and cost-effectiveness of low-carbon solutions.
- National climate and energy strategies implemented by Member States, which can complement or interact with the EU ETS.
- Global energy trends, including fluctuations in energy prices, which may impact fuel switching, investment decisions, and competitiveness.
- Political developments and overall stability in the EU and internationally.
- Complementary EU-level policies, such as the Effort Sharing Regulation (ESR), Renewable Energy Directive (RED), and Energy Efficiency Directive (EED), which jointly influence emissions reductions in the EU.

2.2 Market Stability Reserve

The Market Stability Reserve (MSR) was introduced at a period when the EU ETS was considered to fall short of its potential to reduce emissions. With the economic crisis of 2010, the inflow of offsets from the Clean Development Mechanism and the initially generous cap in the ETS, cumulated allowance supply exceeded allowance demand. In consequence, EUA prices lingered under 10 EUR until the reform in 2018. Much has changed since then. In recent years, price levels have increased considerably and were approximatively 65 EUR per EUA (ICAP Status Report 2025) on average over 2024, i.e. in ranges where the carbon price has an

actual effect on decarbonisation. Part of this success story is the MSR. However, it is difficult to establish the direct impact of the MSR on the rise in ETS price compared to other reform elements, in particular the strengthening of the cap. Therefore, this evaluation of the MSR aims to disentangle, as much as the available data permits, the different effects of the MSR and its consecutive reforms in the period 2013 to 2024.

The evaluation of the MSR has at its centre the evaluation of effectiveness, i.e. if the instrument has achieved its objectives as expected. The findings on effectiveness are complemented by an analysis of the MSR's efficiency, looking at the instrument's costs and benefits, and coherence, analysing how it interacted with other EU and Member State policies. The evaluation of relevance and EU added value happen at the level of the overall EU ETS as the MSR is mainly a design element of the EU ETS strengthening the system to enforce its place as cornerstone of the EU's climate policy.

The purpose of the MSR evaluation is to provide a record of the developments of the past twelve years and extract lessons learned for the future of the EU ETS, as well as for other jurisdictions with ETSs that are considering introducing an instrument like the MSR.

2.2.1 Point of comparison of the MSR

The MSR has evolved through distinct policy reforms and been implemented in consecutive steps that enhanced the mechanism over time until today. Concrete thinking around measures to address the imbalance of cumulated supply and demand in the EU ETS evolved in 2013/14 with expert consultations and an Impact Assessment discussing potential options. This led a year later to the adoption of the MSR. A comprehensive EU ETS reform in 2018 adjusted the way the MSR was planned to work. The MSR then entered into force in 2019. In 2021, the Commission conducted a review of the instrument. Insights from the review were used for a new reform as part of the Fit for 55 package that was adopted in 2023. This section describes the outcome of the 2014 Impact Assessment, the initially adopted MSR and its different reforms. The first expert consultations on the MSR took place in October 2013 with an announcement in January 2014 that the Commission proposes an MSR to be introduced at the start of Phase IV in 2021 to address the supply-demand imbalance in the EU ETS (see EC Memo/14/39).

The Impact Assessment concluded that a structural measure that not only attends to the historical surplus, but also to future demand-supply imbalances is necessary, as the TNAC was expected to grow further over Phase III. Accordingly, Option 1 was concluded to be probably insufficient. A combination of a permanent retirement and the introduction of an MSR together, as proposed by Option 3, was deemed the adequate solution to address both the historical surplus and future imbalances.

2.2.1.1 Initial MSR

The MSR was established by the MSR Decision (EU) 2015/1814 in 2015**.** The adopted version was closest to Option 2d from the 2014 Impact Assessment, choosing an MSR start year of 2019, the middle ground between the two modelled sensitivities of 2017 and 2021. The MSR Decision did not foresee the retirement of allowances, as proposed by the Impact Assessment.

The adopted MSR Decision implemented some modifications on the exact MSR parameters. The upper threshold decreased from 1,000 to 833 million allowances in circulation. The intake rate was set at 12% which leaves the minimum intake at 100 million allowances, which was equivalent to 10% at an upper threshold of 1,000 million allowances (Article 1 (5)). Release

rate and volume were set at the values of Option 2d from the Impact Assessment (Article 1 (6)).

2.2.1.2 2018 reform

Following co-decision, the ETS Directive and MSR Decision were amended in 2018 by Directive (EU) 2018/410. This first major revision of the MSR took place in the process of setting the rules for Phase IV of the EU ETS. The reform enacted a doubling of the MSR intake rate from 12% to 24% as well as the release volume from 100 to 200 million allowances for the initial period of 2019 to 2023 (Article 2(1)) to increase the effectiveness of the mechanism in its initial years.

The 2018 reform also introduced a mechanism to invalidate allowances stored in the MSR as favoured in the 2014 Impact Assessment. Article 2(2) states that from 2023 allowances in the MSR above a volume of the auction volume of the previous year will be retired. This provision brought the implemented MSR closer to Option 3 from the Impact Assessment as it introduced a permanent retirement of allowances (however, it differs substantially in terms of the volume of retired allowances, as the invalidation mechanism applies not only to the 900 million backloaded allowances, but to the entire volume held in the reserve, including unallocated allowances and those absorbed by the MSR via the intake mechanism). The invalidation mechanism was novel as it enacted an endogenous change to the allowance supply in the EU ETS.

2.2.1.3 MSR Review 2021

The Commission conducted a review of the MSR in 2021 (SWD(2021) 601 final) including a legal review of its effects until 2021 and an impact assessment of future design options. The MSR Review is based on a 2021 Vivid Economics study.

The legal review assessed how the TNAC had developed over Phase III and what events and shocks influences the balance of demand and supply in the EU ETS. It also reviewed the effect of the MSR on EU ETS resilience as well as the competitiveness of firms regulated under the EU ETS.

The MSR Impact Assessment of 2021 assessed how the decreases in demand induced by the phase-out of coal-fired power plants as well as the COVID-19 pandemic are addressed by the MSR under different design options for its future refinement. It corrected all scenarios to reflect net demand from aviation and linking with the Swiss ETS in the TNAC calculation.

2.2.1.4 Fit for 55 reform

The Fit-for-55 package, as adopted by Directive 2023/959, reformed the MSR in three ways: First, the period for the application of the increased intake rate of 24% was extended to 2030 (Article 5) to boost MSR effectiveness beyond the introduction period.

Second, a buffer zone for MSR intake was established to reduce threshold effects: For a TNAC between 833 and 1096 million allowances, the MSR takes in the number of allowances exceeding 833 million (Article 5). The buffer zone ensures a gradual increase in volume intake. With the previous parameters, intake increased from zero for a TNAC slightly below the threshold to approx. 200 million allowances (24% times, for example, 834 million allowances) for a TNAC slightly above the threshold (here: 834 million allowances). Under the adjusted rules, the intake at a TNAC of 834 million allowances is only one million allowances and from there increases smoothly. At a TNAC of 1096 million allowances, the existing rule is again in force.

Lastly, the invalidation mechanism has been reformed to invalidate all MSR holdings above 400 million EUAs from 2024 (Article 5a) to increase clarity and stringency of the allowance retirement. The reform entered into force in 2024.

2.2.1.5 MSR point of comparison

Because of the number of reforms of the MSR, the baseline for evaluation is difficult to determine. The years 2014 to 2017 can be compared to the assessment of Option 2d (with MSR start in 2017 and 2021). With the reforms from 2018 and 2023, the MSR has considerably changed.

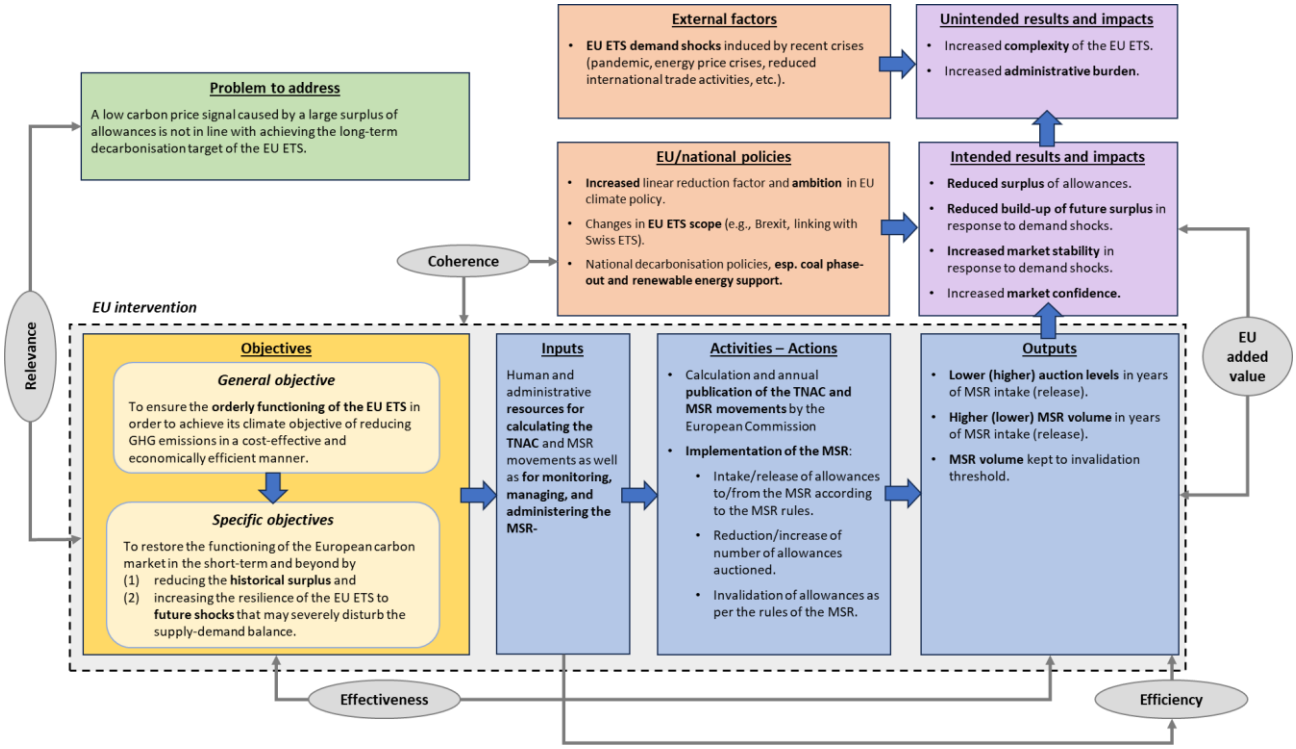
Similarly, the mechanism for permanent retirement envisioned in Option 3 of the 2014 Impact Assessment differs largely from the one implemented in 2023 and further adjusted in 2024. Option 3 consists of retiring 500 million allowances from the 900 million allowances backloaded. That means that instead of returning 300 and 600 million allowances to the auction volumes in 2019 and 2020, only 400 million EUA would have been released, and 500 million EUAs are permanently retired. In contrast, the invalidation mechanism in place does not establish a fixed number of EUAs that would be retired and in practice led to a higher volume of invalidated allowances since it was implemented.

Therefore, it must be concluded that there is no appropriate point of comparison in the 2014 Impact Assessment for evaluating the MSR functioning in the years 2018 to 2024. Instead, the evaluation will draw upon other existing analyses, particularly the MSR Review of 2021, as points of comparison. From the 2021 MSR Review, the MSR0 scenario can serve as point of comparison for the 2019 implemented MSR that is based on the 2018 reform. The MSR1 scenario comes closest to the Fit for 55 reform, although it does not depict a reform of the invalidation mechanism or the introduction of the buffer zone. The reduced upper threshold in this scenario is less problematic as it at least partially matches a downward adjustment of the TNAC in the entire analysis.

2.2.2 Description of the intervention and its objectives for the MSR

Figure 2 provides an overview of the intervention logic to justify the introduction of the Market Stability Reserve. The extent to which the intervention delivered the expected outcomes will be the subject of the evaluation. Each element of the intervention logic diagram below is further discussed in the following subsections.

Figure 2: Intervention logic diagram (MSR)



Source: Own illustration

2.2.2.1 Problem to address

The MSR was adopted to address the large surplus of allowances in the EU ETS prevalent in Phase III. The problem arose in the context of the economic downturn following the crisis of 2010 which reduced the demand for allowances with demand being significantly below allowance supply and the allowance surplus banked by market participants building up (EU COM 2014, p.8ff.).

As a result before the adoption of the MSR Decision in 2015, the EU ETS was perceived as not adequately functioning with allowance prices too low to drive decarbonisation. Alongside the low prices, confidence in the market and the instrument as such was low in the public debate. The initial attempt to drive down the allowance surplus by backloading allowances had not had a sufficient impact.

2.2.2.2 Objectives

The problem to address directly translates into the **general objective of the MSR of ensuring the orderly functioning of the EU ETS** to achieve its climate objective of reducing GHG emissions in a cost-effective and economically efficient manner. This points to two specific objectives: To reduce the historical surplus and to increase resilience of the EU ETS to future shocks and demand and supply imbalances.

The **first specific objective** of reducing the excessive surplus that had structurally built up in the years of the economic crisis and its aftermath can be operationalised as reducing the total number of allowances in circulation (TNAC). The TNAC is the difference between the cumulative supply of allowances since the beginning of the EU ETS reduced by the allowances placed in the Market Stability Reserve and the cumulative number of allowances that left the market because they were used to settle surrender obligations. The TNAC represents the

number of allowances held by market participants, both compliance entities and financial actors.

The **second specific objective** of enhancing future resilience of the EU ETS market consists of three parts. First, the MSR should prevent the build-up of future surpluses (from a 2014 perspective). In other words, the MSR should intervene at an early stage in case supply significantly exceeds demand, for instance because of another economic crisis. Second, the MSR should ensure market stability in reaction to shocks. Climate policy needs to function in an environment of economic crises and other shocks. The objective of the MSR is to prevent these shocks from having a destabilising effect on the EU ETS market. Third, the MSR should increase the confidence in the EU ETS and strengthen long-term market expectations. This objective is driven by the notion that by adopting the MSR the EU signals to the market and the general public that it considers the EU ETS as a key instrument for driving decarbonisation in the EU.

2.2.2.3 Inputs

Establishing the MSR and improving upon its design has required human and administrative resources, e.g. for legal and economic analysis.

Operating the MSR requires human and administrative resources for monitoring, managing, and administering the reserve. While it did not create additional data needs to calculate the TNAC, and derive the MSR movements from it, a process for the annual communication of the TNAC and the MSR intake needed to be established.

2.2.2.4 Actions

The intervention relied on two types of actions. The first set of activities concerned the adoption of the regulatory framework around the establishment and operation of the MSR. This included the formal MSR decision as well as its subsequent amendments. The first amendment to the MSR introduced a mechanism to invalidate allowances in the MSR as well as the temporary increase of the intake rate of 24% instead of 12% from 2019 to 2023 in the 2018 reform of the ETS Directive. The second amendment was part of the Fit for 55 package that reformed fundamental MSR parameters (smoother intake rules for the buffer zone of a TNAC between 833 and 1096 million allowances and prolongation of the 24% intake rate until 2030) as well as the invalidation threshold that capped the MSR volume at a fixed level of 400 million allowances.

The second set of activities concerns the implementation of the MSR. It consists of the calculation and annual publication of the TNAC and the corresponding MSR movements (i.e. intakes, releases, or invalidations), if any. Based on this calculation, the actual implementation of the MSR can take place that involves moving allowances from the auction volume of a year to the MSR or vice versa, which would then have an impact on the auction volumes for the 12-month period starting in September. It also involves invalidating allowances placed in the MSR if its volume exceeds a certain threshold.

2.2.2.5 Output

An output of an intervention refers to direct outputs of the activities undertaken. In this sense, the MSR has three outputs:

- First, the volume of auctioned allowances in years of MSR intake are lower than in a counterfactual scenario without the MSR. They are higher in years in which allowances are released from the MSR.

- Second and accordingly, the MSR volume increases or decreases in response to intake or release of allowances.
- Third, the MSR volume is limited to the invalidation threshold in any given year.

2.2.2.6 Intended results and impacts

There are several intended results from this output.

- Most importantly, the MSR should achieve a reduction of the historical surplus of allowances.
- In case of demand shocks, there would be only a limited build-up of a new surplus as the MSR would automatically remove allowances from the auction volumes.
- Overall, the market would be more stable and resilient in reaction to future demand shocks and the overall confidence in the market would be strengthened.

2.2.2.7 Unintended results and impacts

The MSR potentially led to unintended results and impacts:

- It increased the complexity of the functioning of the EU ETS, making assessments of future developments regarding supply and demand of allowances as well as allowances prices more challenging.
- Similarly, it potentially increased the administrative costs for the EU Commission and for EU ETS authorities in Member States.

2.2.2.8 External factors

The main external factor relevant for the MSR is the occurrence of external demand shocks. For the MSR evaluation, external demand shocks are assessed with a similar approach to "intended" demand shocks induced by complementary EU or national policies like the phase-out of coal-fired power plants or renewable energy support policies. This builds on a categorisation developed in the 2021 MSR Impact Assessment and the underlying Commission study.

Like the COVID-19 pandemic in 2020/21, the energy price crisis induced by the Russian invasion of Ukraine in February 2022 and reduced international trade activities in response to a global economic downturn have had significant influence on industrial emissions and electricity demand and in consequence on the demand for EU ETS allowances.

2.2.2.9 EU/national policies

The MSR works in the context of the broader EU climate policy. It is significantly influenced by increased ambition, e.g. through the 55% reduction target until 2030 which translated into a more stringent cap reduction in the EU ETS through an increased linear reduction factor. The cap reform reduced the allowance supply and in consequence the TNAC that drives MSR movements.

The MSR is also impacted by other changes in the EU ETS design, especially changes regarding the EU ETS scope. This includes the departure of the United Kingdom and its installations, the scope expansion to include the maritime sector as of 2024 and the linking with the Swiss ETS. These events influenced supply and demand of the allowances under the EU ETS.

Complementary EU or national policies like the German coal phase-out or renewable energy support policies caused another category of EUA demand shocks interacting with the MSR. These effects are assessed in this evaluation.

To a limited extent, the MSR was also used as vehicle for releasing 27 million allowances to the market to replenish the Innovation Fund to compensate for its contribution to financing the REPowerEU amendment of the Recovery and Resilience Facility, potentially impacting the intended results of the MSR.

3 HOW HAS THE SITUATION EVOLVED OVER THE EVALUATION PERIOD?

Following the 2018 review, the ambition of the ETS cap was enhanced further in a revision to the ETS Directive in 2023 that increased the ETS reduction target to 62% below 2005 levels and made free allocation in some circumstances conditional to additional efforts (i.e. implementing energy audit recommendations or developing and implementing carbon neutrality plans).[15] Within this revision, the adoption of the Carbon Border Adjustment Mechanism (CBAM) is taken into account by outlining the phase-out schedule of free allocation for sectors covered by the CBAM (i.e. steel, cement, fertilisers, hydrogen and aluminium) up until 2034. An accompanying targeted review of the MSR prolonged the 24% intake rate until 2030 and included the fine-tuning of certain elements of the mechanism, amongst which introducing a buffer mechanism for intakes, to address potential threshold effects when TNAC is close to the upper threshold.

4 EVALUATION FINDINGS (ANALYTICAL PART)

4.1 To what extent was the intervention successful and why?

4.1.1 EU ETS

4.1.1.1 Effectiveness

The effectiveness of the EU ETS in achieving its objectives is evaluated based on the following questions examined under points 4.1.1.1.1 to 4.1.1.1.6.

4.1.1.1.1 What were the overall emissions reductions associated with the EU ETS sectors?

Since its inception in 2005, emissions from stationary installations, including both power and industrial facilities, have decreased by around 50% in 2024 (see Figure 3). Between 2018 and 2023, emissions from regulated entities under the EU ETS (covering combustion plants, industry, and aviation) dropped substantially, with most of the reduction driven by the power sector. According to the European Environment Agency (EEA)[16], emissions from stationary installations (thus excluding aviation) fell by 16.7% in 2023 compared to 2022, which represents the largest annual emissions reduction in the scheme's history.

Focusing only on energy-intensive industries (i.e. stationary installations excluding combustion), emissions fell by 17.1% between 2005 and 2024. At the same time, the EEA found that the combined GVA of energy-intensive industries remained broadly stable while emissions fell, indicating a positive decoupling from economic activity within the sectors.[17]

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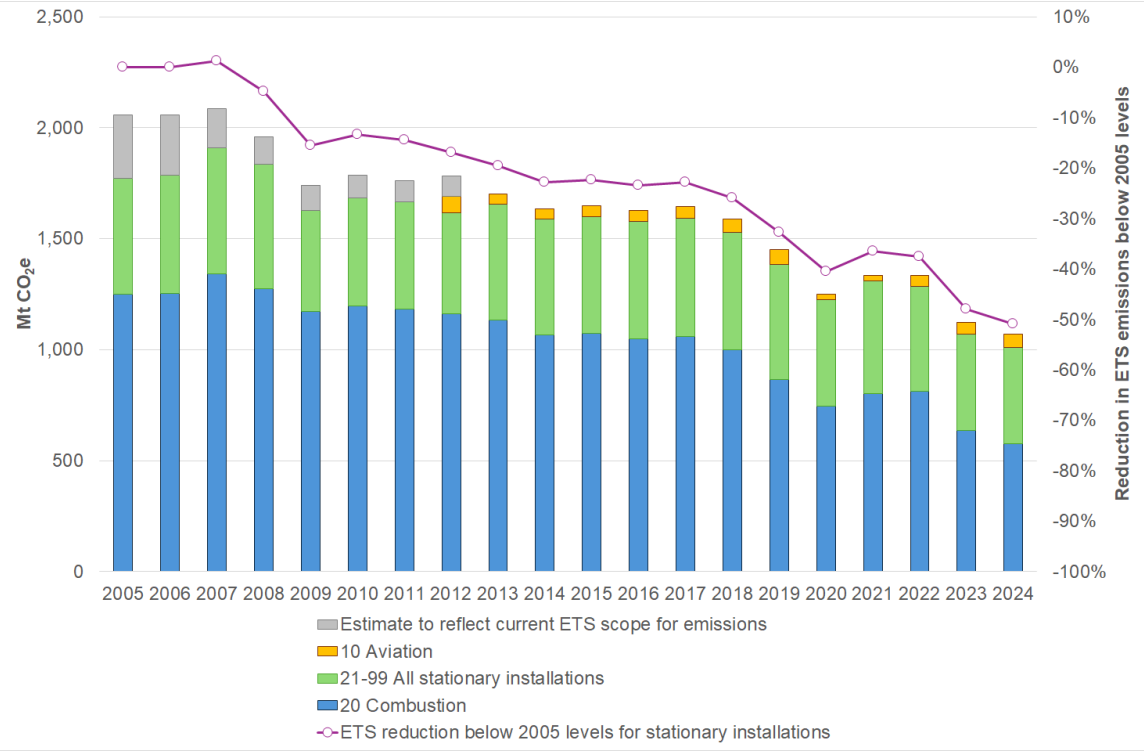
15 Directive - 2023/959 - EN - EUR-Lex

16 EEA Greenhouse gas emissions under the EU Emissions Trading System, https://www.eea.europa.eu/en/analysis/indicators/greenhouse-gas-emissions-under-the

17 EEA Briefing 01/2026: Zero-pollution, decarbonisation, and circular economy in energy-intensive industries, ISBN: 978-92-9480-753-3 - ISSN: 2467-3196 - Doi: 10.2800/4884883

Figure 3: Comparison of the development of total EU-27 emissions within the EU ETS, disaggregated by activity



Source: Own illustration based on information from EU Emissions Trading System (ETS) data viewer (EEA)

The power sector has thus been the primary contributor to decarbonisation. This reflects the fact that free allocation for the power sector has largely been phased out since 2013. Therefore, the carbon price is fully transmitted to the wholesale electricity price. For example, when the marginal producer setting the market price is a fossil fuel power plant, it is expected that the market price also includes the carbon cost of that fuel.[18] Evidence of the full cost pass-through of carbon prices to wholesale power prices in Belgium, Germany, Italy, the Netherlands, Scandinavia and the United Kingdom for the period 2008-18 has recently been provided in a study by Bai and Okullo (2023).[19]

The power sector has witnessed a sharper decrease in emissions since the start of the EU ETS. The increase between 2020 and 2022 was initially most likely due to the rebound effect following the COVID-19 crisis, but it also reflected the impact of the energy crisis following Russia's illegal invasion of Ukraine (refer to Section 4.1.1.1.2).

The overall trend of declining emissions in the EU power sector demonstrates the transition to clean power, which according to Ember[20] reached a tipping point in 2025 with wind and solar

[18] European Commission, 2025. "Trends in carbon intensity and the macroeconomic role of the EU Emissions Trading System - Economy and Finance", https://economy-finance.ec.europa.eu/trends-carbon-intensity-and-macroeconomic-role-eu-emissions-trading-system_en

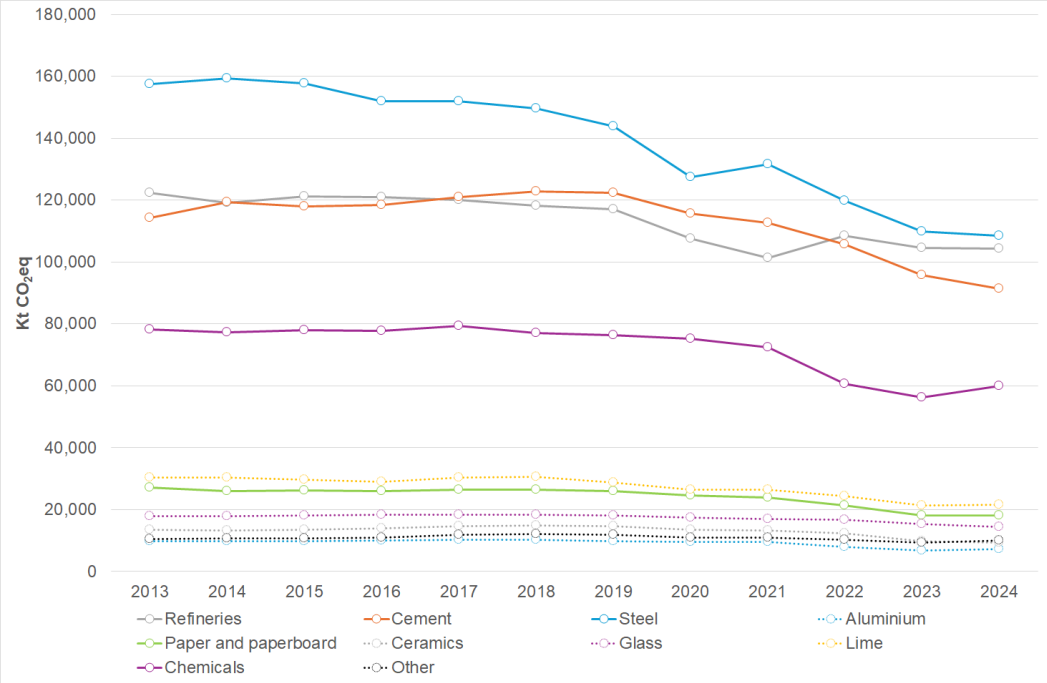
[19] Bai, Yiyi & Okullo, Samuel J., 2023. "Drivers and pass-through of the EU ETS price: Evidence from the power sector," Energy Economics, Elsevier, vol. 123(C).

[20] Ember Report, 2026. "European Electricity Review", https://ember-energy.org/app/uploads/2026/01/EMBER-Report-European-Electricity-Review-2026.pdf

power generating more electricity than fossil sources for the first time. Indeed, wind and solar accounted for 30.1% of EU electricity in 2025 (841 TWh), whereas all the fossil power sources in the EU accounted for 29% (809 TWh). Between 2020 and 2025 the share of EU power from wind and solar has increased by more than 10 percentage points and this is in stark contrast to electricity generation from fossil fuels, which has declined by almost 8 percentage points over the same period.[21]

Emissions reduction from industry (excluding combustion) was mainly driven by the following sectors: production of steel (including activities preliminary to steel production, namely metal ore roasting or sintering, production of ferrous metals, production of coke); production of cement clicker; refining of mineral oil. The more recent decline in industrial emissions is primarily due to lower levels of activity (see also Section 8.3.4) but also reflects, to a lesser extent, improvements in the performance of installations in terms of their specific emissions.

Figure 4: Development of total EU-27 emissions within the EU ETS, breakdown of all stationary installations (excl. combustion), by most emitting activities



Source: Own illustration based on information from EU Emissions Trading System (ETS) data viewer | Maps and charts | European Environment Agency (EEA)

Feedback from the Open Public Consultation strengthens the validity of the findings. A clear majority of respondents judged the EU ETS to be delivering on its main objective of reducing GHG emissions. About half of the respondents[22] considered it moderately effective, nearly one-fifth very effective, while only a small share viewed it as ineffective.

[21] Ibid

[22] Question: "How effective do you think the ETS Directive has been in achieving its objective to reduce greenhouse gas emissions?"

4.1.1.1.2 To which extent can the emissions reductions (if observed) be attributed to the application of the Directive?

In an ideal situation, we would expect to see the following if the application of the Directive was effectively reducing emissions aligned with the cap trajectory.

- Emissions from ETS sectors would reduce
- Activity levels from ETS sectors would decouple from emissions

Such a decoupling of activity from emissions would be a clear indication of the effectiveness of the Directive. While we have observed emission reductions this has, however, not been accompanied by increased levels of activity in recent years (refer to Section 8.3.4.1). It is therefore necessary to try and understand the role of the carbon price signal in influencing the lower levels of activity as opposed to external factors beyond carbon pricing.

The starting point for any evaluation into the extent to which the emission reductions observed in the previous section can be attributed to the application of the Directive should involve an initial assessment of the relative exposure of each of the ETS covered sectors to the carbon price signal.

Relative exposure of each of the ETS covered sectors to the carbon price signal

The relative exposure to the carbon price signal reflects both the provision of free allocation to shield against the carbon cost and the cost of abatement to avoid the carbon cost.

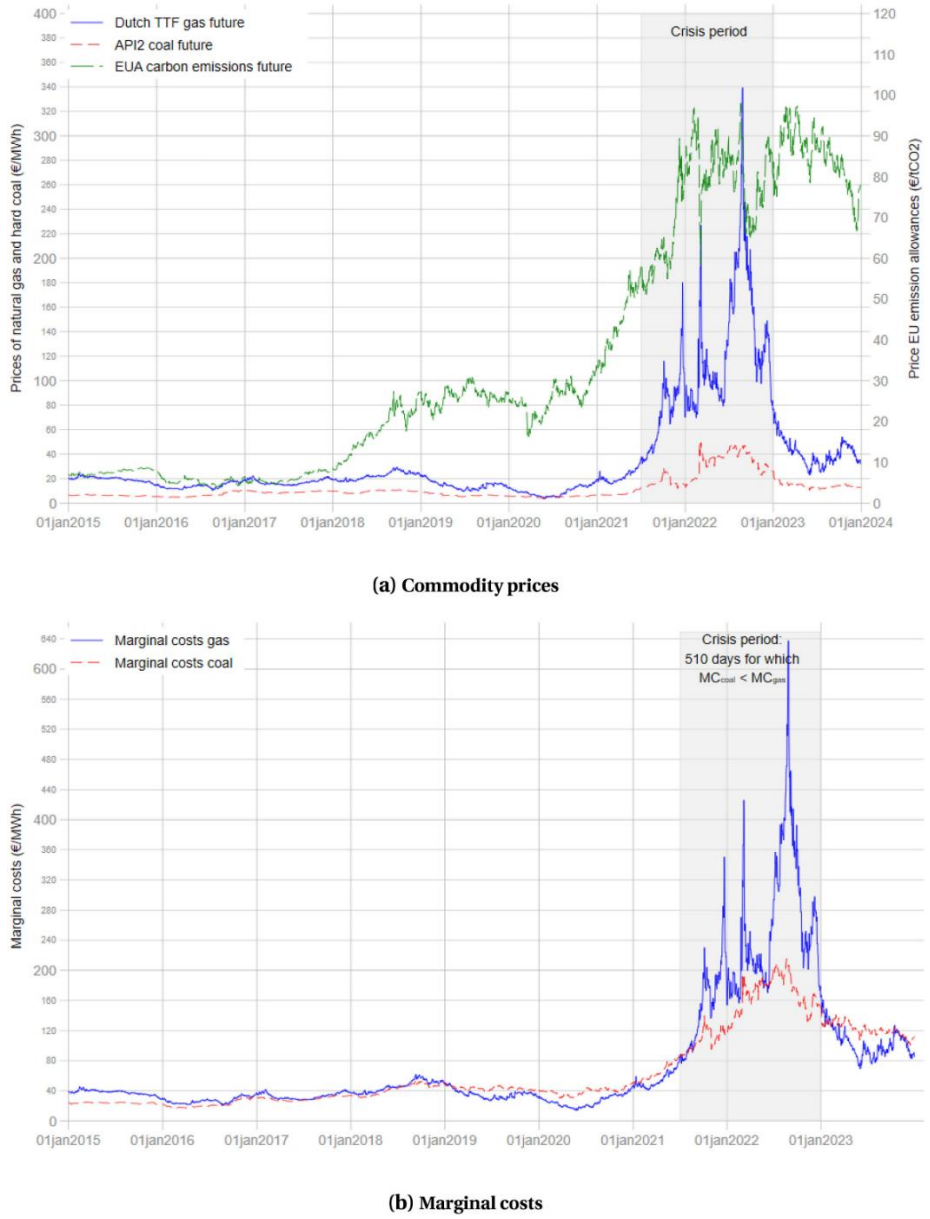
Free allocation to the power sector has been very limited since the start of Phase III with most generators required to purchase allowances to cover their verified emissions. The power sector has therefore been exposed to the carbon price signal, and this has provided an incentive for the uptake of abatement options (i.e. switching from fossil fuels to renewables and using technologies like nuclear and hydropower in electricity generation) to avoid the cost of compliance.

Emission reductions in the power sector have taken place at a faster rate in comparison to industrial sectors. This resulted from of a combination of policy support, market structure, and technical opportunities. EU and national policies promoting renewable energy, including the RED and national support schemes like feed-in tariffs, premiums, auctions, and, more recently, PPAs, have been decisive in scaling up wind and solar capacity. These structural shifts were reinforced by the functioning of the wholesale power markets. Because the costs of emissions allowance are reflected in the marginal cost of production, electricity generators can pass most of the carbon price through to electricity price.

Indeed, Liebensteiner & Kimani (2026)[23] show evidence of fuel switching from coal to gas in the power sector (i.e. the marginal cost of coal was higher than the marginal cost of gas) from the start of 2019 until mid-2021 driven in part by an increase in the price of EU allowances following reforms to the EU ETS (see Figure 5). However, the energy crisis following Russia's illegal invasion of Ukraine temporarily reversed this trend between 2022 and 2023 as the marginal cost of natural gas increased significantly and Liebensteiner & Kimani (2026) argue that this is likely to have resulted in a switch back from gas to coal and an increase in GHG emissions. Fuel switching from coal to gas started again post 2023 following the end of the peak of the energy crisis related to Russia's illegal invasion of Ukraine.

[23] Mario Liebensteiner, Alex Mburu Kimani (2023)

Figure 5: Development of prices and marginal costs in the EU power sector



Source: Environmental and health costs of Europe's shift from gas to coal amidst the energy crisis[24]

An important indicator of industry's exposure to the carbon price signal is to examine the ratio of free allocation to verified emissions.[25] At the start of the third phase of the EU ETS, this ratio was very high for all industrial ETS sectors (even higher than the level of reported emissions for some sectors) and, combined with a very low EUA price, resulted in emission trends remaining relatively flat across industrial sectors. However, from the interviews with industrial stakeholders, there was a consensus that free allocation has been effective in

[24] Liebensteiner, Mario and Kimani, Alex Mburu (2023)

[25] The exact ratio is difficult to calculate for certain sectors such as the iron and steel sector due to the transfer of waste gases from the blast furnace impacting the balance as the waste gas may be emitted elsewhere under other economic activities. For this reason, the balance between verified emissions and free allocation from the EEA Data viewer are not presented

preventing carbon leakage, although many suggested that the effectiveness of free allocation has declined following the Phase IV reforms to free allocation rules (especially with regards to the reduction of the BM values).

Better targeted benchmarks in Phase IV and provisions to better align free allocation with actual levels of production indicate that the selected benchmarks for Phase IV (2021-25) are in most cases lower than the average emissions for 2021/22 and this indicates that the benchmarks have been set to incentivise further improvements in performance over Phase IV.

As the share of emissions covered by free allocation has declined in Phase IV due to more ambitious benchmarks this results in many industries suggesting that they are now facing a shortage in allowances. However, approximately 80-90% of the verified emissions of industry have nevertheless remained covered by free allocation at the start of Phase IV of the EU ETS[26]. Therefore, it is highly unlikely that, despite a considerable increase in the EUA price and changes to the provision of free allocation in Phase IV, it is unlikely that they alone are responsible for the observed reduction in industrial emissions (refer to work undertaken in Section 8.3.4.1). Indeed, it is more likely that the emission reductions observed are primarily driven by a decline in levels of activity across industrial sectors in response to a range of external and unexpected events, unrelated to the ETS. Understanding the factors underlying the decline observed in activity is important for any evaluation to assess the effectiveness of the Directive.

While free allowances continue to protect industry from a high share of the direct cost of carbon, the extent to which the rising EUA price could have been passed through indirectly via electricity prices may have had a downward effect on the international competitiveness of European producers. Carbon leakage protection measures have, to a certain extent, offset this impact via indirect cost compensation (although ICC does not cover all sectors and is applied differently in the Member States that implement it).

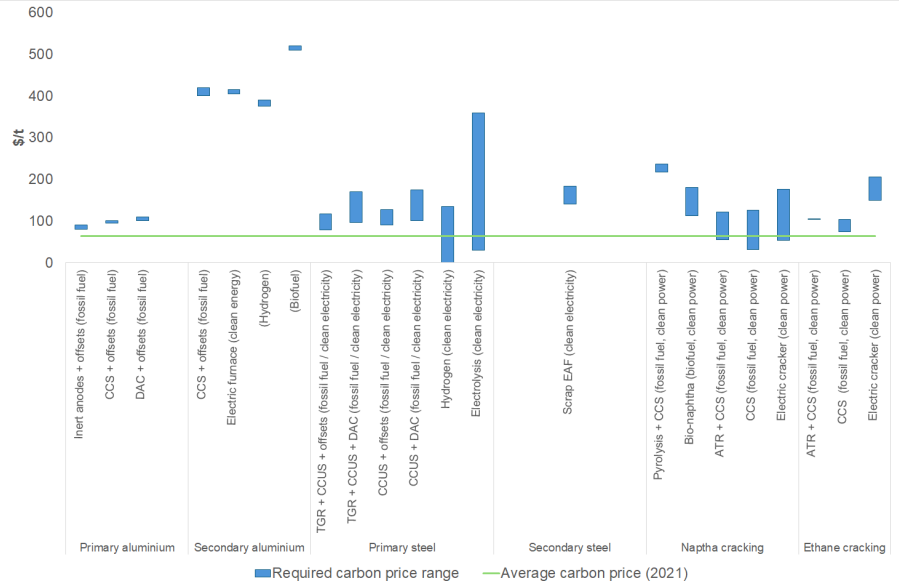
Based upon extensive interviews with industrial stakeholders during the consultation period, it was frequently explained that the reduction in activity levels has been the primary driver of the observed recent emission reductions. This can be attributed largely to the increase in energy prices observed since the start of Phase IV of the EU ETS as a result of several external events. However, industrial stakeholders indicated that the unilateral nature of the carbon cost has most likely also contributed to a difficult situation in terms of their recent competitiveness.

Several studies highlight that the EU ETS has largely failed to incentivise breakthrough innovations in these sectors. Carbon prices have remained below the threshold needed to make transformative technologies commercially viable. For example, the various carbon abatement options in the chemical industry can reach up to EUR 500 t/CO2[27]. According to modelling by BloombergNEF, the upper estimates of the required carbon price necessary to make a new-build net-zero technology financially viable exceeded the average EU carbon price in 2021 across a range of different abatement options in the aluminium, chemical and steel sectors (see Figure 6)

[26] Own calculations

[27] Lennard Rekker, Michaela Kesina, Machiel Mulder, 2023, "Carbon abatement in the European chemical industry: assessing the feasibility of abatement technologies by estimating firm-level marginal abatement costs", https://doi.org/10.1016/j.eneco.2023.106889.

Figure 6: The estimated required carbon price range to make selected abatement options financially viable in the aluminium[28], chemicals[29] and steel sectors[30] compared to the average EU carbon price in 2021



Note: The average carbon price is based upon the annual average EUA auction price in 2021 accessed via the EEX and converted from EUR to USD using an average conversion exchange rate of 1.18 provided by OFX.[31]

Source: Own illustration based BloombergNEF data

There remains, however, a lot of uncertainty with regards to the marginal abatement cost of technological potentials across industry and this was reflected by a reluctance from stakeholders during interviews to provide an exact marginal cost per tonne of abatement. However, several stakeholders provided an indicative range of expected marginal abatement costs or explained the abatement options available in more detail.

- *Eurofer* noted that "with regards to the abatement costs per tonne for abatement potentials such as hydrogen steel, DRI and CCUS the numbers remain uncertain and potentially out of date now as it does not take into account impact of the recent energy crisis, but figures ranged from 100 to 200 EUR per tonne of abatement." However, it was also added that a "comparison between the EU carbon price and the abatement costs does not reflect the business reality of investment decisions, which is heavily impacted by the international competition, both on the existing carbon intensive technologies, but also on the low carbon ones as well as on whole value chains."
- *Cement Europe* stated that "at a minimum, the EUA price would need to reach levels of at least 200 EUR otherwise the cement sector simply does not have the business case

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28 For abatement options in the aluminium sector carbon price refers to what is required to make a new build net zero technology competitive with existing BAU technologies. A range of abatement prices are provided without specifying the year(s) of the required carbon price range.

29 For abatement options in the steel sector carbon price refers to what is required to make a new build net zero technology competitive with existing BOF or scrap EAF capacity. 2050 values assume that all technologies have reached NOAK costs.

30 For abatement options in the chemicals sector carbon price refers to what is required to make a new build net zero technology competitive with new build BAU technology. 2050 values are provided without a further explanation on how they were derived.

31 Yearly average rates - OFX (UK)

for deep decarbonisation without other funding options. So, the implication that arises is that the ETS as currently designed is not sufficient to drive the transformation required with additional reform and most likely without complementary policies to address issues that are beyond the control of the cement sector to influence directly."

- *Fertilisers Europe* outlined several options, but all are currently associated with challenges undermining their potential uptake:
    - CCS: Is regarded as the most realistic measure that could become more financially viable with the carbon price rising but there are issues regarding complementary policies that are preventing the uptake of CCS in the fertiliser sector such as planning for CCS plants and the legislative requirements for such plants being set too high from day one.
    - Biomethane: While biomethane potentially could run within the existing production process the cost of biomethane is very high and in insufficient volume to make a shift at scale.
    - Electrification of ammonia production: The increase in production costs (potentially as high as four times the current cost production) is prohibitive and current provision of subsidies insufficient.
- *European Aluminium* highlighted the use of an inert anode as an important abatement option for reducing direct emissions but made clear that while technically possible this is not currently available at scale and is unlikely to be a viable option before 2035 and were not prepared to speculate on the cost of abatement. CCS and CCU would represent a fall-back option to the use of an inert anode, but these technologies are expensive to deploy. European Aluminium also refers to the uncertainty currently among their members in deciding upon their investment strategy. Should more money be invested in CCS ready smelting process now or should investment be delayed until the use of inert anodes or even direct air capture are available at scale?
- *Cefic* presented the key technologies that would help the chemical sector to reduce GHG emissions. These include:
    - Alternative energy carriers and sources: such as electrification, hydrogen as energy carrier, steam & heat from biomass and Small Modular nuclear Reactors (SMRs)
    - Circular carbon feedstock to close the carbon loop: using waste, CO_2 and bio-based feedstock.
    - Other solutions: Hydrogen from alternative production routes; process optimisation; CO_2 capture and storage.

Cefic declined to provide more detail on the marginal abatement costs for each of the proposed technologies as "it is extremely complex as it depends on the location where the technology project is implemented (i.e. country of implementation) and specificities of the project itself."

An important benefit of including a large number or relatively diverse portfolio of sectors within the coverage of the EU ETS, all with different abatement costs, is that the emissions trading system can self-optimise which emissions can be abated most efficiently in the short-term and medium-term, while sectors with higher abatement costs (or complex abatement solutions) can plan the necessary measures for the long-term.

Despite the increase in the carbon price in recent years, the marginal cost of many abatement options remained higher across industrial sectors and therefore was insufficient to drive transformative change. Free allocation rules granted to emissions intensive, and trade exposed industries have historically lowered the price signal, thus reducing the incentive to invest in

decarbonisation technologies. Moreover, compared to the power sector, industry was not supported by other policies that encouraged the shift towards low carbon production. Indeed, industrial stakeholders were keen to emphasise that enabling conditions beyond the carbon price needed to also be delivered to encourage investments in low carbon technologies. The impact of changes to the free allocation in Phase IV, including the effects on incentives for abatement, are the focus of the evaluation for the topic of carbon leakage and further assessment on this is provided in Section 8.3.

Given that emissions were reduced over time in both the power and industrial sectors and both were exposed (albeit to different extents) to the carbon price signal, the following subsections summarises evidence from the literature that aimed to attribute the role of the EU ETS to the emission reductions observed.

Impact of the EU ETS on emission reductions in the power sector

The decline in emissions from the power sector must be considered in the broader context of reduced industrial activity. The more recent downturn in industrial output, driven by the energy crisis, high input costs, and weaker demand in energy-intensive sectors, contributed to a temporary reduction in electricity demand and, therefore, in power sector emissions (see Section 8.3.4 for more details).

Beyond these cyclical factors, emissions reduction in the power sector has been driven by a combination of the ETS price signal and a set of supporting policies[32]. The record drop in 2023 (-16.7% year-on-year) was driven largely by the accelerated deployment of renewable energy sources in the power sector facilitated by a robust carbon price. The increased uptake in renewable energy sources has been encouraged by different forms of public support schemes, including at the national level. Among the key support schemes, feed-in tariffs and feed-in premiums (including contracts-for-difference) have been implemented to expand renewable energy generation[33]. Country evidence shows that explicit coal phase-out policies also played a crucial role in emissions reduction via fuel switching. In Germany, for example, auctions for compensated closures retired 10GW of coal capacity between 2020 and 2022 at low cost, while cancelling free allowances[34]. These policies, combined with the increase in EUA prices, strengthened incentives for fuel switching from coal to gas, and made low-carbon investment more attractive. A recent econometric post-assessment of the ETS[35] applies a Bayesian structural time-series model to monthly emissions in 24 Member States, constructing a counterfactual path that controls for fuel prices, demand, weather, renewable generation and an index of overlapping policies and measures. The study attributes a 19% reduction in emissions from the power sector during Phase III to the ETS, net of other drivers.

Impact of the EU ETS on emission reductions in industrial sectors

The decline in emissions from the power sector must be considered in the broader context of reduced industrial activity. The more recent downturn in industrial output, driven by the energy

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32 REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL on the functioning of the European carbon market in 2023, SWD(2024) 264 final

33 European Commission, 2023. "The Development of Renewable Energy in the Electricity Market", https://economy-finance.ec.europa.eu/system/files/2023-06/dp187_en_energy%20markets.pdf

34 Silvana Tiedemann, Finn Müller-Hansen, 2022. "Auctions to phase out coal power: Lessons learned from Germany", https://doi.org/10.1016/j.enpol.2022.113387.

35 Ethan Eslahi, Anna Creti, María-Eugenia Sanin, 2025. "Mission accomplished? A post-assessment of EU ETS impact on power sector emissions reduction", https://doi.org/10.1016/j.ecolecon.2025.108784.

crisis, high input costs, and weaker demand in energy-intensive sectors, contributed to a temporary reduction in electricity demand and, therefore, in power sector emissions (see Section 8.3.4 for more details).

While the energy crisis is likely to have played an important role in driving the emission reductions that have occurred in recent years across industry, there is evidence of the carbon price also influencing emission reductions. Overall, according to a study by the European Investment Bank[36], the observed emissions reduction in regulated entities within the manufacturing sector can be directly attributed to the application of the ETS Directive, especially to the Phase IV revision. The study reveals that the effect of the ETS prices on carbon efficiency and emissions reduction is more pronounced for sectors transitioning away from free allocation and into auctioning. Sectors that lost their carbon leakage status in Phase IV tended to improve their carbon efficiency to a larger extent and tended to have lower direct emissions compared to those that retained carbon leakage status. This suggests that when sectors bear the direct cost of their emissions, the incentives for them to reduce emissions is higher. A 2023 study[37] confirms that the emissions reduction experienced in Phase III of the ETS is attributed to increasing stringency in the Directive, which led to companies purchasing more EUAs due to a significant reduction in free allocation and stricter enforcement of rules. Incentives to decarbonise within the EU ETS are enhanced when companies are required to purchase allowances instead of receiving them for free. The linear reduction factor, which tightens the path of the emissions cap, furthers enhances this effect by increasing stringency and allowance scarcity.

Evidence shows that higher ETS prices have fostered carbon efficiency and emissions reductions within the EU manufacturing sectors. More specifically, the study by the European Investment Bank estimates the elasticity of carbon efficiency and emissions with respect to ETS prices on a panel of manufacturing sectors from 2012 to 2022. Using a difference-in-differences design, the authors conclude that a 1% increase in ETS prices leads to an improvement of carbon efficiency by 0.04% and a decrease in emissions of 0.05% in regulated sectors. This suggests a positive correlation between rising ETS prices and environmental performance. Moreover, the increase in the EUA price during Phase III of the ETS had a statistically significant and substantial impact on the emissions reduction compared to Phase II. More specifically, a study by Bordignon & Gamannossi degl'Innocenti[38] employs a quasi-experimental econometric approach based on panel data from 2008 to 2020 to estimate that, for each additional allowance bought, there was a decrease in emissions of approximately 0.5 tonnes of CO_2-eq. The study conservatively estimated of a total emission emissions reduction in CO2-eq is of 422 Mt, which represents 22.5% of the average yearly EU ETS emissions or 4.3% in Phase II. CO2-eq. The significant reduction is attributed to a tightening of ETS regulation.

The empirical literature provides growing support for a causal contribution of the EU ETS to emissions reductions in covered sectors, with increasingly robust identification strategies applied over time. Evidence based on long-run aggregate data is provided by Klimko and

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36 European Investment Bank, 2024. "A positive trade-off: Emissions reduction and costs under Phase IV of the Emissions Trading System", https://www.eib.org/attachments/lucalli/20240297_economics_working_paper_2024_05_en.pdf

37 Bordignon, M., & Gamannossi degl'Innocenti, D. (2023). Third Time's a Charm? Assessing the Impact of the Third Phase of the EU ETS on CO_2 Emissions and Performance. https://doi.org/10.3390/su15086394

38 Ibid

Hasprová (2025)[39], who analyse annual EU27 data covering the period 2005-2022, spanning all four trading phases. Using ordinary least squares (OLS) regressions, the authors relate total ETS-covered CO_2e emissions to macroeconomic variables, including GDP, total and corporate investment, the average EUA market price and a time trend. Their results show a statistically significant negative relationship between allowance prices and emissions, as well as a negative role for corporate investment, suggesting that the ETS price signal and capital adjustment are important drivers of emissions reductions over time. While this approach does not employ a counterfactual or quasi-experimental design and therefore does not allow phase-specific causal estimates, it provides consistent econometric evidence that the ETS has been an important explanatory factor behind the decline in ETS-covered emissions between 2005 and 2022.

Stronger causal identification for the EU ETS prior to Phase IV is provided by the European Central Bank (2023)[40], who use sector-level panel data covering the period 2000–2016, covering the first three trading phases. Their empirical strategy combines fixed-effects panel regressions with a difference-in-difference-in-difference design, exploiting variation across time, sectors and regions. Specifically, they compare emissions trends in ETS-regulated industries within the EU to the same industries in non-EU regions and to unregulated sectors, therefore constructing a credible counterfactual for emissions developments in the absence of the ETS. The authors estimate an average treatment effect of approximately six percentage points, indicating that emissions declined significantly faster in regulated EU sectors following the introduction and tightening of the ETS than in comparator groups. Although the analysis does not extend into the fourth trading period, it provides robust causal evidence that the ETS accelerated emissions reductions beyond what would have happened in absence of the intervention due to global trends, sectoral restructuring or other contemporaneous policies alone.

Direct causal evidence for the fourth trading period is provided by Willemaers (2025)[41,] who focuses specifically on the Phase IV reforms affecting free allocation. The study uses installation-level data from the EU Transaction Log covering the period 2015-2023, capturing both the end of Phase III and the first years of Phase IV implementation. The empirical strategy exploits the exogenous, policy-driven reduction in free allocation that occurred between 2020 and 2021 following benchmark updates and a narrower carbon-leakage list. Treatment intensity is defined as the installation-specific loss of free allocation, and causal effects are estimated using a continuous difference-in-differences design with installation and year fixed effects, complemented by an event-study analysis to test for parallel pre-trends. The results show that a 10% reduction in free allocation is associated with roughly 3.5% lower verified emissions in the post-2021 period. This finding provides quantitative evidence that the tightening of effective carbon constraints in Phase IV translated directly into lower emissions at the installation level, strengthening the causal attribution of observed reductions to the Phase IV design of the EU ETS.

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[39] Klimko, Hasprovà, 2025. “The impact of the EU ETS on Greenhouse Gas Emissions in the EU from 2005 to 2022”, ECONOMICS AND ENVIRONMENT11(92)

[40] ECB Working Paper Series No 2764 / January 2023, Benefits and costs of the ETS in the EU, a lesson learned for the CBAM design https://www.ecb.europa.eu/pub/pdf/scpwps/ecb.wp2764~3ff8cb597b.en.pdf

[41] Arthur Willemaers, 2025. “Cutting Free Allocation Cuts Emissions: Evidence from Phase IV of the EU ETS” (Working Paper). 2025. ⟨hal-05400137⟩

An additional study by the European Central Bank (2026)[42] compares the effects of a weaker carbon price signal pre-2017 and of the stronger carbon price signal following the regulatory reforms analysed in this evaluation. The study is based on a sample of over 5000 EU ETS installations, representing approximately 90% of the total verified emissions in the EU ETS. The study concludes that a weak carbon price signal generates little meaningful firm-level response, with the pre-2017 EU ETS emissions largely unchanged among regulated firms. However, the rise in carbon prices after 2017, due to the reform of the EU ETS and the start of the MSR operations resulted in firms exposed to carbon pricing reducing their emissions, while maintaining output and therefore implying efficiency gains rather than output contractions. Thirdly, ECB study finds that the market for corporate control emerges as a channel through which firms realize these efficiency gains, with the high-exposed manufacturing firms significantly increased their acquisitions of green targets after 2017.

Feedback from respondents in the OPC was mostly aligned with the findings. Many respondents[43] pointed to the rise in carbon price in recent years (13% of respondents) and the tightening of the cap for Phase IV (26% of respondents) as concrete evidence of the system's effectiveness, and several respondents also cited observed emission reductions – particularly in the power sector – as proof that the ETS can drive abatement. At the same time, some stakeholders (7% of respondents) argued that a portion of power-sector cuts stemmed from complementary renewable-energy and coal-exit policies rather than the ETS alone, and a few industry respondents felt that, although prices have risen, they were not high or predictable enough to drive transformative investment. More details on the OPC responses are in the Synopsis Report.

4.1.1.1.3 How do the observed effects correspond to the objectives of the Directive?

The objective of the ETS Directive is to reduce emissions in a cost-effective way, incentivising firms to invest in low carbon solutions and reducing emissions by putting a price on them. The improvement in carbon efficiency and reduction in emissions is identified as key objective of the ETS. Figure 7 shows the development of verified emissions in relation to the EU ETS cap over time. It shows a consistent downward trend in terms of emissions reductions. Verified emissions were lower than the annual cap in each year of Phase II of the EU ETS but this mainly reflected the onset of the economic recession of 2008/09 that mean that levels of activity were lower than anticipated when the cap was initially set. Therefore, policy interventions (i.e. such as the backloading of allowances or the introduction of the market stability reserve) subsequently managed the balance between the supply and demand of allowances, which increased levels of scarcity as the number of allowances in circulation was lower than verified emissions. Such scarcity has strengthened the carbon price signal over Phase III and especially into Phase IV and provides further incentives for long-term investments in low carbon technologies.

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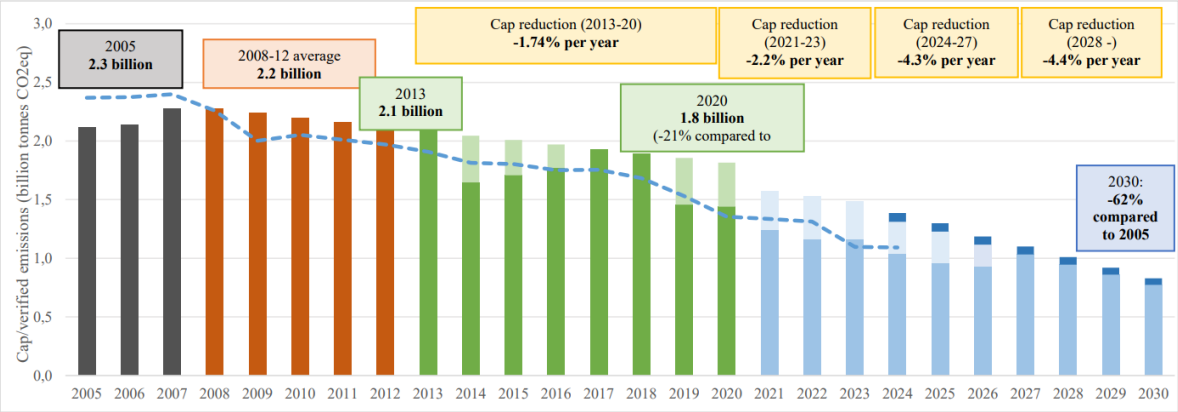
[42] European Central Bank Working Paper Series, No 3253 (2026), "Climate Regulation, firm emissions and green takeovers", Climate regulation, firm emissions, and green takeovers

[43] Question: "Please provide specific examples or evidence to support your assessment of effectiveness of the ETS Directive and MSR Decision", 218 respondents

Figure 7: Evolution of the EU ETS cap from 2005 up until 2030 compared with verified emissions[44]



Note: Emissions cap in the EU ETS compared with verified emissions. The figure considers the 2023 revision of the ETS Directive, i.e. rebasing of the cap in 2024 and 2026, including the maritime transport sector in the EU ETS from 2024 and the linear reduction factor of 4.3% in 2024-2027 and 4.4% from 2028. Aviation is not included. Due to changes in scope, the 2005-2007 figures are not directly comparable with the latest ones.

From 2021, the EU ETS no longer covers installations in the UK, only electricity generators in Northern Ireland. From 2024, verified emissions in the figure also include the maritime sector, hence the 2024 and 2023 emissions are not comparable. Legend: bars (cap), light shaded bars in 2014-2016 (allowances backloaded from auctions), light shaded bars from 2019 (feeds of allowances to the Market Stability Reserve), dark shaded bars from 2024 (maritime scope extension), dashed line (verified emissions).

Source: Own illustration

Evidence from the literature supports the argument that the ETS has been successful in enhancing carbon efficiency in regulated sectors. A study by Dechezleprêtre & al, (2023)[45] conclude that the EU ETS has been successful in reducing carbon emissions, and at the same time did not impact negatively economic performance and output. Instead, the study finds that the EU ETS led to a statistically significant increase in revenue and fixed assets of regulated firms, and it had no significant impact on profits or employment. This suggests that the system induced investment, which might have increased productivity. Phase IV has effectively accelerated sectors' reduction of carbon emissions[46]. The more stringent rules in Phase III contributed to reduced emissions, while having an insignificant negative impact on capital, labour productivity, and output[47].

In terms of investments incentives, a study by Boungou & Dufau (2024)[48] shows that firms in regulated sectors immediately reacted to the Phase IV announcement in the 2015 proposal by increasing their R&D spending, which boosted output competitiveness despite a reduction in

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44 REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL on the functioning of the European carbon market in 2024, SWD(2025) 388 final

45 Antoine Dechezleprêtre, Daniel Nachtigall, Frank Venmans, 2022. "The joint impact of the European Union emissions trading system on carbon emissions and economic performance", https://doi.org/10.1016/j.jeem.2022.102758.

46 European Investment Bank (2024)

47 Bordignon, M., & Gamannossi degl'Innocenti, D. (2023)

48 Whelsy Boungou, Bastien Dufau, 2024. "EU ETS Phase IV and Industrial performance", https://doi.org/10.1016/j.econlet.2024.111596.

employment, which has been explained as substitution of labour with more productive capital. Lin & al (2019)[49] confirms that the EU ETS is consistent with the Porter Hypothesis, which states that environmental regulation can lead to increased efficiency and reduced costs. More specifically, the study finds that the innovation compensation effect generated by the EU ETS compensates the additional cost imposed on regulated entities, as observed in the pulp-and-paper sector. This outcome is in line with the overarching ETS objectives of reducing emissions while ensuring economic viability.

The ETS played a role in accelerating the phase-out of coal and has supported incremental innovation, such as improving energy efficiency and increasing patent activity in covered sectors[50]. Some studies show a modest increase – up to 10% – in patenting in ETS-covered sectors compared to others, particularly for technologies that were near market-ready[51]. However, the price signal has not been strong or stable enough to drive transformational change, particularly in sectors like steel, cement, or chemicals that require innovation and infrastructure change. While there were examples of the carbon price driving rapid abatement (i.e. the improvements in the specific emissions of adipic acid production), energy intensive production such as hot metal for steel remains very limited. This likely reflects the high share of free allocation that remains available to industry as well as the carbon price not yet reaching a level that would make the more innovative abatement solutions financially viable. For additional details on the effectiveness of the carbon leakage prevention measures, see Appendix III, Section 8.3.4.1.

In addition, the impact of the Innovation Fund and Modernisation Fund in incentivising low carbon solutions is assessed in a separate evaluation (SWD(2026) 199) and SWD(2026) 197).

4.1.1.1.4 Has the revised ETS Directive been successful in improving the functioning and the resilience of the carbon market by addressing the surplus of allowances (which was identified in Phase III) by strengthening the MSR and increasing the LRF?

A surplus of allowances in the carbon market weakens the carbon price signal. The revision of the ETS Directive addressed this issue by strengthening the MSR rules and increasing the LRF, which defines by how much the cap of allowances reduces over time. The effect of these reforms has been increasingly visible. The carbon price rose steadily from around EUR 5/tCO_2 in 2017 to over EUR 80/tCO_2 in 2021, reaching levels that begin to reflect the external cost of emissions more accurately. Although the MSR has helped address some volatility, in Phase III, ETS allowances prices still fluctuated based on external shocks and trading behaviour, which weakened the long-term credibility of the price signal.[52] Nearly two thirds of all OPC respondents[53] consider the MSR moderately to very effective in addressing the structural

[49] Weiming Lin, Jianling Chen, Yi Zheng, Yongwu Dai, 2021. "Effects of the EU Emission Trading Scheme on the international competitiveness of pulp-and-paper industry", https://doi.org/10.1016/j.forpol.2019.102021.

[50] Nguyen, P.-V. and Pellerin-Carlin, T., 2021. "The EU ETS: from cornerstone to catalyst", https://institutdelors.eu/en/publications/the-eu-ets-from-cornerstone-to-catalyst/

[51] R. Calel, A. Dechezleprêtre, 2016, Environmental policy and directed technological change: evidence from the European carbon market

[52] Europea Court of Auditors, Special Report 18 2020, The EU's Emissions Trading System: free allocation of allowances needed better targeting

[53] Question: "How effective has the MSR Decision been in addressing the structural surplus of allowances that had accumulated in the EU ETS since 2009 (n=282)"

surplus of allowances in the EU ETS, including a majority of both private sector respondents and NGO respondents.

According to the European Investment Bank (2024)[54], the reforms introduced to address the oversupply of allowances have been successful in increasing the carbon price and thus increasing compliance with the EU ETS and reduction in carbon emissions.

A more detailed analysis on addressing the surplus of allowances via the implementation of MSR is provided in Section 4.1.2.

4.1.1.1.5 Has the EU ETS MRVA system supported the overall effectiveness of the EU ETS?

The detailed evaluation of the MRVA system presented in Appendix III, Section 8.4 concludes that the MRVA system ensured robust, transparent, consistent, and accurate monitoring and reporting of greenhouse gas emissions from industrial installations and aircraft operators. It examines four main aspects: the accuracy, completeness, and transparency of emissions data, the system's ability to prevent errors and misreporting,, the effectiveness of the verification and accreditation processes in ensuring reliable data and compliance with EU ETS rules; the extent to which Member States have improved MRVA procedures and how these improvements have influenced overall compliance; and finally, how well the MRVA system has adapted to emerging challenges and what further enhancements could strengthen its effectiveness.

The MRVA system delivers high harmonisation and accuracy with standard methods used almost universally. The MRVA system ensures that nearly all emissions from activities listed in Annex I of the ETS Directive are monitored and reported, with only marginal delays or omissions**.** Clarity and consistency of reported data under the EU ETS MRVA remain high, supported by established inspection procedures, though their scope and frequency vary across Member States**.** Strict approval procedures and harmonised templates ensure a consistent and non-arbitrary application of monitoring methodologies across the EU ETS.

Verification under the EU ETS ensures that operators apply EU-approved methodologies and emission factors, and that emissions data are independently verified for accuracy. The EU ETS verification system ensures stringency and independence through robust accreditation, annual oversight, and consistently high compliance, though emerging capacity pressures because of the expansion of ETS activities pose risks to the quality of verification. Annual verifier audits provide comprehensive on-site coverage and effectively identify discrepancies, but recent findings suggest room for greater consistency across verifiers. There is a high level of confidence in the system's integrity and robustness, and competent authorities report that verified data are dependable enough to be used directly for compliance assessments, surrendering the right number of allowances and international greenhouse gas inventories, demonstrating institutional trust in verification outcomes. The accreditation framework under the AVR remains proportionate and robust.

Overall, the MRVA framework has proven adaptable to the evolving policy and operational challenges that arose over the evaluation period.

[54] European Investment Bank (2024)

4.1.1.1.6 Has the EU ETS auctioning system supported the overall effectiveness of the EU ETS?

The EU ETS auction system has been evaluated for its effectiveness in allocating emission allowances transparently and equitably across the EU. It operates in an open manner with well-defined rules and publicly available procedures, providing transparency and predictability for participants. The EEX, the appointed auction platform, manages auctions consistently and effectively for all member states and the EEA countries. To date over 3000 auctions were conducted with minimal cancellations, illustrating its reliability. The ETS auctions raised over 169 billion EUR in auction revenue during the period of the evaluation (and over 250 billion EUR in total to date). Auction volumes were calculated accurately, adhering to regulatory requirements. Results are published promptly, providing comprehensive information to stakeholders. Equitable access to allowances is ensured for all eligible parties, including SMEs, although many opt to use intermediaries in the secondary market. The system's regulatory framework, bolstered by MiFID II and MAR, prevents market manipulation and abuses, maintaining the integrity of the EU ETS. The EEX offers training and support for smaller emitters to encourage participation, contributing to the stable and competitive nature of the auctions. Overall, the auctioning system has successfully achieved its objectives and ensured a balanced distribution among different market participants.

4.1.1.1.7 Has the EU ETS registry system supported the overall effectiveness of the EU ETS?

The Union Registry has been evaluated for its effectiveness to maintain a reliable and secure IT system for tracking the creation, allocation, surrender and reversal of allowances. From 2018 to 2023, the Union was operational 99% of the time and encountered only minor technical interruptions due to scheduled upgrades, and some unexpected technical difficulties in 2020 causing temporary unavailability. The Registry effectively provides accurate, up-to-date, and publicly accessible information crucial for ETS reporting, ensuring transparency and accountability and supporting compliance monitoring, market integrity, and informed decision-making. However, a challenge is the limited availability of Legal Entity Identifiers (LEIs) for financial supervisory purposes, though these are being gradually integrated. The technical rules and requirements sufficiently support account holders and representatives.

Ensuring adequate security has been in focus, with a framework developed to protect data confidentiality and system integrity. Yearly IT Security Plans address potential risks through mitigation strategies. Although historical security measures have been effective, evolving risks, particularly the risks of cyber-attacks and issues like inadequate financial or human resources, underline the need to strengthen the security of the infrastructure and to revise the operating model. Studies and security plans have identified vulnerabilities, recommending additional security measures to adapt to the growing IT risks and market changes.

4.1.1.2 Efficiency

The efficiency of the EU ETS in achieving its objectives is evaluated based on the following questions:

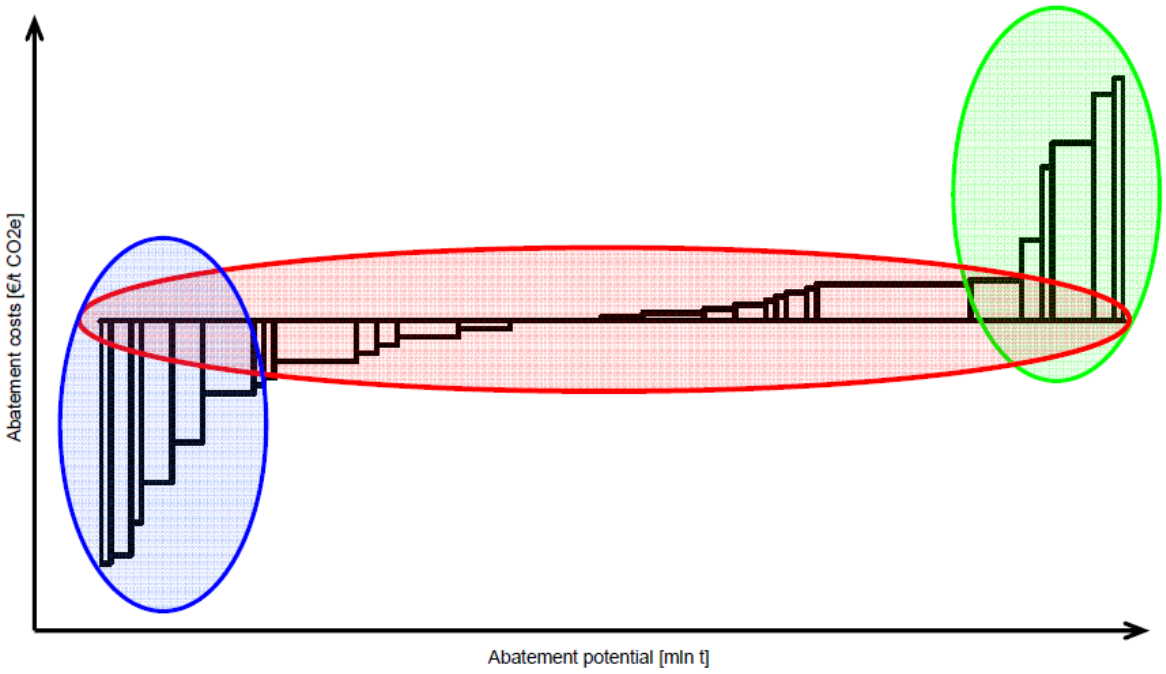
4.1.1.2.1 To what extent has the Directive been successful in achieving its objectives compared to alternatives, e.g. command and control measures, taxation?

From an efficiency perspective, the ETS Directive has generally been more successful in delivering cost-effective GHG emissions reductions than other regulatory approaches (namely,

command and control measures, and carbon taxes) and, in several respects, compares favourably with carbon taxation.

Figure 8 illustrates this relationship using a stylised marginal abatement cost curve. The central segment of the curve, where abatement options are more mature and cost-competitive, is well suited to market-based instruments, such as cap-and-trade systems or carbon taxes which equalise marginal abatement costs across the emitters. On the other hand, the left-hand side of the curve shows "locked" low or cost-saving potentials that are hindered by non-price barriers and usually require complementary regulatory measures, efficiency standards, or targeted incentives. At the opposite end, on the right-hand side, sit innovation-intensive or infrastructure-dependent options that require technology-specific support and long-term investment frameworks. The figure also helps to visualise how different policy instruments operate: a cap-and-trade system fixes the total quantity of emissions (i.e. how far an economy moves along the x-axis) and allows the market to determine the corresponding carbon price; a carbon tax fixes the price per tonne and allows the level of abatement to adjust accordingly; command-and-control measures prescribe fixed measures that do not necessarily correspond to the lowest points on the curve, which might result in overall higher costs.

Figure 8: Marginal Abatement Cost Curve



Source: Öko-Institut[55]

Cap-and-trade systems such as the EU ETS combine the advantages of quality control with market flexibility. The Directive sets a total cap on emissions from covered sectors and distributes allowances, which firms may trade, ensuring that reductions occur where they are cheapest. In theory, according to Stavins (2022)[56], if taxes and trading are designed

[55] Öko-Institut, 2010. "Greenhouse gas emissions trading and complementary policies. Developing a smart mix for ambitious climate policies". Developing an ambitious climate policy mix

[56] Stavins, Robert N., 2022. "The Relative Merits of Carbon Pricing Instruments: Taxes versus Trading". Review of Environmental Economics and Policy 16, no. 1 (2022): 1-21. ttps://www.journals.uchicago.edu/doi/abs/10.1086/717773.

equivalently, they yield the same marginal incentives and aggregate abatement costs. In practice, experience shows that emissions trading has instead achieved larger cost savings compared to command-and-control rules, as in the US SO_2 programme[57], and that the EU ETS itself has delivered substantial reductions at moderate cost once early design flaws were corrected. Chen & al (2020)[58] similarly finds that cap-and-trade can reduce emissions more effectively than a carbon tax when allowance prices are robust, while rewarding firms that develop or adopt cleaner technologies.

The efficiency of the EU ETS has been shaped by its market design. Initial over-allocation of permits and price volatility limited abatement incentives in the initial phases. Recognising these shortcomings, the EU gradually improved the ETS. From Phase III onwards, substantial reforms were introduced to improve market functioning and to ensure the credibility of the price signal. Notably, the system moved from decentralised allocation to a centralised EU-wide cap, tightened the supply of allowances, introduced benchmarking for free allocation based on the most efficient installations, and made auctioning the default method for allocating allowances. The 2018 revision of the EU ETS reinforced this outcome by tightening the emissions cap, integrating the MSR to address surplus and price volatility (see Section 4.1.2), and further shifting from free allocation to auctioning and better targeting the allowances still allocated for free, thus improving the carbon price signal and allocative efficiency. The system has also induced innovation and emissions reduction in power generation and industrial processes, an outcome that rigid standards rarely achieve and that carbon taxes have encouraged only when rates were high and predictable[59].

Carbon taxes retain certain advantage, namely offering predictable marginal costs and a simpler legal structure and avoiding the price volatility sometimes seen in allowance markets. Taxes can also raise stable revenue without the complexity of allowance auctions or registries. However, they do not guarantee emissions reduction, and their rates are often diluted for competitiveness or equity reasons, which undermines efficiency. Command-and-control measures remain important where market failures or information problems prevent efficient market responses, but they are widely recognised as inferior as a primary climate instrument because they do not have the cost-minimising potential of trading or taxing[60].

Overall, the existing evidence from both theoretical and empirical studies suggests that the EU ETS has delivered significant efficiency gains compared with prescriptive regulation and has matched, and often exceeded, the cost-effectiveness of taxation. By aligning abatement across

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57 The sulphur dioxide (SO2) allowance-trading programme established under Title IV of the 1990 Clean Air Act Amendments (CAAA) was the world's first large-scale pollutant cap-and-trade system. The stated purpose of the Acid Rain Program was to reduce total annual SO2 emissions in the US by ten million tons relative to 1980, when total US emissions were about 26 million tons. In a departure from conventional environmental regulation, the legislation did not prescribe how power plants would reduce their SO2 emissions. Instead, with a phase-in beginning in 1995 and culminating in 2000, the statute capped aggregate SO2 emissions at the nation's 3,200 coal plants and created a market for firms to buy and sell government-issued allowances to emit SO2. By 2007, annual emissions had declined below the programme's nine-million-ton goal (a 43% reduction from 1990 levels), despite electricity generation from coal-fired power plants increasing more than 26% from 1990-2007 (EPA 2012; EIA 2011). (Stavins, Robert N. "The U.S. Sulphur Dioxide Cap and Trade Programme and Lessons for Climate Policy." Vox. August 12, 2012.)

58 You-hua Chen, Chan Wang, Pu-yan Nie, Zi-rui Chen, 2020 "A clean innovation comparison between carbon tax and cap-and-trade system", Energy Strategy Reviews, https://doi.org/10.1016/j.esr.2020.100483.

59 Ibid

60 Stavins, Robert N. (2022)

firms and providing flexibility over time, the Directive has reduced emissions at lower aggregate cost, while also stimulating technological change

4.1.1.2.2 To what extent are the costs resulting from the implementation of the Directive proportionate to the changes/effects it has achieved?

Cost of free allocation

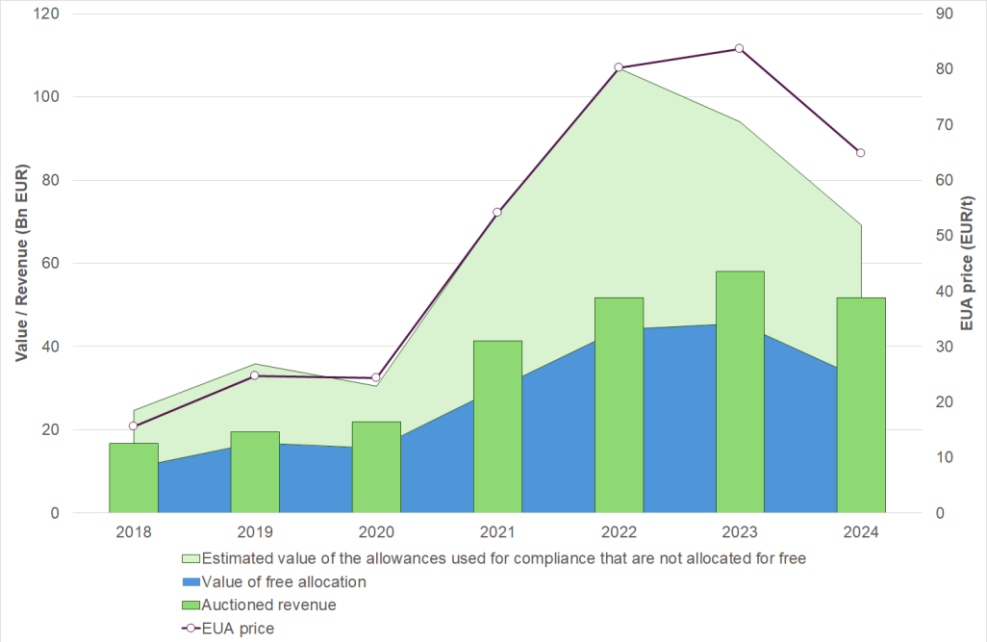
The EU ETS has created significant value in the form of allowances by placing a price on the right to pollute. The blue area in Figure 9 provides an estimation of the value of free allocation by multiplying the volume of total free allocation (includes volumes for free allowances allocated under Article 10a(1), Article 10a(7) and Article 10c) for each year by the average annual EEA price. The overall value of the free allocation provided is estimated to be around EUR 195 billion over the 2018-24 period.

The light green shaded area in Figure 9 shows an estimated value for the allowances used for compliance that were not allocated for free, and this was calculated by subtracting the total verified emissions for the EU-27 by the total free allocation for the EU-27 and then multiplying the difference by the average carbon price for the relevant year based on EEX report data.

Over the 2018-2024 period, the value of allowances that were assumed to be used for compliance and not allocated for free is estimated to be around EUR 238 billion. The value of the allowances used for compliance that were not allocated for free was then subsequently compared with actual annual data on auctioning revenues from the EEX platform (i.e. refer to the green bars in Figure 9). In practice, operators may not always go to the market for allowances as this will depend on whether they are long or short of allowances and whether they need allowances to cover their emissions (this will vary depending upon the uptake of abatement options as well as external events impacts activity and therefore emissions). The increase in revenues for the auctioning of allowances in recent years has been driven by the strengthening of the carbon price signal over the period.

In a counterfactual situation whereby all the allowances were auctioned, the value of allowances that were assumed to be used for compliance and not allocated for free over the 2018-2024 period would increase to around EUR 433 billion. This valuation assumes that operators do nothing to reduce their exposure to the carbon price, which is unlikely to be the case so the estimation should be viewed as the maximum potential value.

Figure 9: Estimation of the value of allowances compared to actual revenues from auctioning



Source: EEA EU ETS Data viewer (2025), EEX market reports, Own calculation.

While free allocation helps shield European industry from competitiveness impacts, it also distorts the carbon price signal by reducing the effective carbon cost faced by firms.[61][62] Sectors with higher pass-through capacity firms may pass the notional cost of allowances to consumers while still receiving them for free, leading to windfall profits rather than actual emissions reductions or innovation. A report by CE Delft[63] identified cost pass through to be the largest driver of windfall profits, with an estimated EUR 26-46 billion after adjusting for market share losses. This study shows that in almost all sectors, the additional profits from cost pass through largely outweighed any loss in profits due to reduced market share. The iron and steel, refineries and cement sectors accrued respectively EUR 16 billion, EUR 12 billion, and EUR 7 billion of windfall profits from carbon cost pass through[64].

Although cost pass through helps internalise the cost of carbon, windfall profits arising from free allocation do not necessarily contribute to decarbonisation. Free allocation is considered to be the primary cause of windfall profits under the ETS. As the system matures, a reduction in free allowances, combined with increased auctioning and the full implementation of the EU CBAM is expected to reduce these undue rents and improve the system's effectiveness, while still shielding industries from international competition. The extent to which the cost of free allocation is considered proportionate will ultimately depend on whether free allocation prevented the relocation of industry due to carbon pricing. There is not yet firm evidence of

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61 Nguyen, P.-V. and Pellerin-Carlin T. (2021)

62 Scotti, F., Flori, A., Crescenzi, R., & Pammolli, F., 2025. "Demand-pull and technology-push environmental innovation: a policy mix analysis on EU ETS and EU Cohesion Policy". *Climate Policy*, *25*(2), 153–170. https://doi.org/10.1080/14693062.2024.2366894

63 Additional profits of sectors and firms from the EU ETS 2008-2019, Delft, CE Delft, May 2021

64 However, the cost pass through rates applied in the CE Delft study were based on a range of literature sources that are not accepted by industrial sectors who argued strongly during the stakeholder consultation that their ability to pass through costs were very limited.

carbon leakage occurring at a large scale (refer to Section 8.3.4.1) and industrial stakeholders have also frequently noted during interviews undertaken for the evaluation of the importance of free allocation in limiting the relocation of industry due to carbon pricing.

Costs and benefits for different stakeholders - Member States, industry sectors and SMEs

The distribution of costs and benefits under the EU ETS varies across Member States, industry sectors, and firm sizes. Member States bear administrative costs related to the operation of national registries, MRV systems, enforcement, and the allocation and auctioning of allowances. At the same time, Member States receive most of the revenues from the auctioning of allowances, which governments can reinvest in climate and energy programmes. Regulated industries face compliance obligations, as they must monitor emissions, surrender allowances, and bear the cost of purchasing permits if free allocation is insufficient. Energy-intensive or trade-exposed sectors often benefit from free allocation, and/or cost compensation for indirect carbon costs, helping to mitigate the competitiveness risks and to reduce the cost imposed on firms. Larger companies can take advantage of economies of scales to spread additional costs, including reporting costs caused by MRV compliance, across greater output, hedge against allowance price volatility, and invest in efficiency or fuel-switching technologies to reduce their emissions and thus the cost of complying with the Directive. SMEs typically face proportionally higher compliance costs because MRV compliance may need to be outsourced and capital for low-carbon investment is generally scarcer. SMEs might gain from ETS flexibility and provisions for smaller firms. SMEs can choose the lowest-cost abatement options, bank or sell surplus allowances if they reduce emissions below their cap, and, in some cases, obtain free allocations or apply for EU or national funds (e.g., Innovation Fund) financed by auction revenues. These elements offer opportunities to offset part of the administrative burden, although access depends on sector eligibility and the firm's capacity to engage with support mechanisms. At EU level, the European Commission bears administrative and analytical costs associated with the period review of benchmarks and the preparation of the carbon leakage list, as well as for the maintenance and security of the Union Registry. The 2018 revision increased these responsibilities by expanding the scope of benchmarking and carbon leakage assessment.

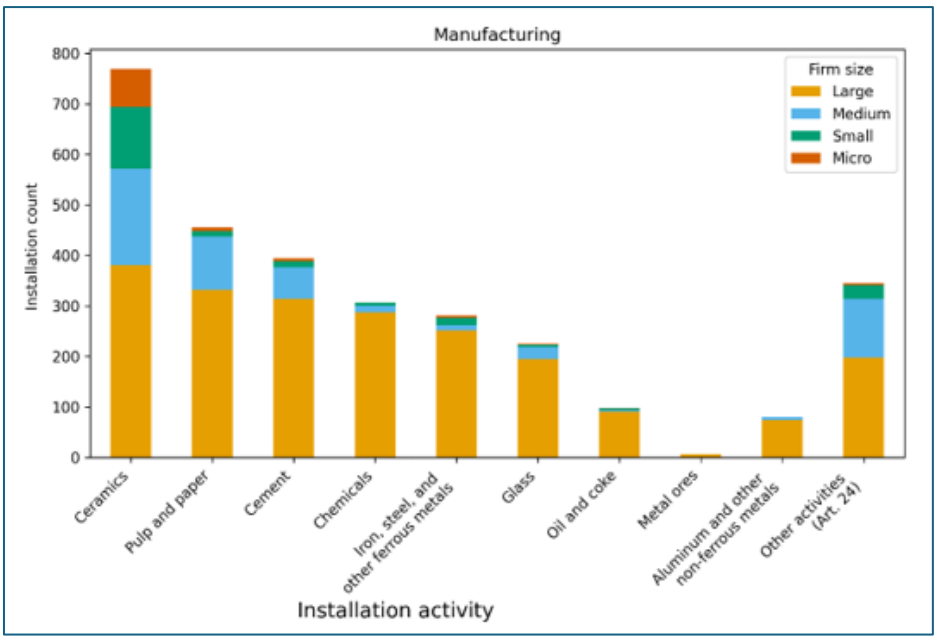
Evidence from the Open Public Consultation (available in Annex 2 of the Impact Assessment) shows that most respondents consider the overall cost of implementing the EU ETS to be moderate or good compared with the environmental and market outcomes, although a sizeable minority, especially smaller operators and energy-intensive industries view administrative requirements as burdensome. These perceptions are echoed in the targeted operator survey on free allocation, which found that, compared with Phase III, most installations reported either slightly or significant higher administrative costs when applying for free allocation in Phase IV. The increase was most frequently mentioned by combustion, lime/dolomite, ceramics, and other energy-intensive sectors. Across company sizes, most respondents reported an increase in administrative and compliance costs, but larger installations (>500), which are the most represented size in the survey in terms of responses, more often indicated that costs had increased significantly, while micro-operators (<10 employees) were more likely to either report a slight increase or being unsure.

In addition to the public consultation, analysis of SME coverage by EU ETS was conducted using the Orbis database (a commercial database that contains economic and financial data on around 600 million companies worldwide) and an ETS matching tool developed by the

European Commission[65]. This analysis identified companies in the database that are operators of ETS installations, and identified which of these were SMEs, using the official European Commission definitions[66]. Micro enterprises have fewer than 10 employees and a turnover, or a balance sheet total not exceeding EUR 2 million; small enterprises have fewer than 50 employees and a turnover, or a balance sheet total up to EUR 10 million; and medium-sized enterprises have fewer than 250 employees, with a turnover not exceeding EUR 50 million or a balance sheet total not exceeding EUR 43 million. The Orbis database has known limitations (in particular under-representation of small firms and uneven representation across countries) but was nevertheless considered the best tool available for conducting analysis of the corporate structure of ETS operators (as opposed to the size of their installations).

The analysis identified 7,685 operators of stationary ETS installations and found that 26% of these were SMEs. Most of these were medium-sized enterprises (19%) rather than small (6%) or micro (2%). It also found that the ceramics sector had the highest proportion of SMEs, in particular micro and small enterprises, as Figure 10 shows.

Figure 10: Number of ETS operators per sector and company size identified in Orbis analysis



Source: Own calculation

To improve the proportionality and reduce compliance costs across stakeholder groups, the 2018 ETS Directive introduced targeted interventions addressing administrative and financial burdens. Article 10(4) requires that auctioning rules guarantee full, fair, and equitable access for SMEs and small emitters and ensure that participation remains cost-efficient and does not impose undue administrative costs. Article 27a(1) further allows Member States to exclude very small installations from the ETS, namely those emitting less than 2500 tonne/CO_2-eq annually, or operating for less than 300 hours per year, provided that adequate measures are in

[65] European Commission, "Matching the EU Transaction Log to the Orbis database" https://single-market-economy.ec.europa.eu/single-market/chief-economist-business-intelligence-unit/analytical-work/single-market-industry-and-competitiveness/matching-eu-transaction-log-orbis-database_en

[66] Commission Recommendation of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises. ELI: http://data.europa.eu/eli/reco/2003/361/oj

place, and thus avoiding disproportionate compliance costs. Introduced prior to the 2018 revision, Article 27(1) continues to allow Member States to exclude installations emitting less than 25,000 tCO_2e per year provided they are subject to equivalent national emission reduction measures.

The Orbis analysis mentioned above was undertaken in 2025, after the 2018 revision. This implies that the SMEs identified are either operating installations with capacities above the thresholds of Art 27 / Art 27a, or that the Member States where they are located have chosen not to exercise the exemptions permitted by these articles.

Overall, the provisions introduced by the 2018 revision aim to streamline administration, enhance cost-effectiveness, and ensure that the burden of participating in the EU ETS better reflects each stakeholder's capacity and exposure to competitive pressure.

4.1.1.2.3 Has the monitoring, reporting and verification of greenhouse gas emissions covered by the EU ETS been carried out cost effectively and are there any apparent options for simplification with a view to reduce administrative burden on relevant stakeholders?

The detailed evaluation of the MRVA system presented in Appendix III, Section 8.4. concludes that MRVA costs are not perceived to have increased significantly between Phase III and Phase IV although reported costs associated with MRVA are higher than previously identified. Based on a standard cost methodology, total costs for all operators of stationary installations range from EUR 0.2 – 0.9 billion per year. When expressed as cost per tonne of emissions, this gives a range of 0.2 to 0.8 euro/tonne CO_2.[67] These costs per tonne CO_2 are higher than in the 2016 administrative cost study,[68] which gave an average of EUR 0.16 per tonne CO_2. This cost increase can be explained by inflation, increases in labour costs and the inclusion of some costs for free allocation in the estimates. However, it is also possible that some efficiencies, for example through implementing standard tools, more harmonisation between Member States and improving guidance, may have been offset by additional requirements in some areas such as those related to the requirement of the operator to demonstrate compliance of biomass fuels with sustainability and greenhouse gas savings criteria laid down in the Renewable Energy Directive. Even though some stakeholders indicated that the requirements related to metering for stationary installations have become more cost intensive, there is no clear reason for that emanating from the regulation. Compared to 2016 the rules on measurement of fuel consumption or material production have not changed significantly. However, these costs remain small per unit of emissions.

Aircraft operators generally face smaller MRVA costs per unit of emissions than operators of stationary installations, except for verification fees. The relatively more straightforward monitoring and reporting requirements for the aviation sector contribute to lower costs and fewer days staff-time for MRVA activities. Based on 378 active aircraft operators, total costs ranged from EUR 12 – 20 million. With total emissions of the aviation sector of 54 $MtCO_2$ in 2023[69], the costs range from EUR 0.2 - 0.4 per tonne CO_2. The fact that verification fees are similar to those for stationary installations is in itself not strange but the fact that the number of days spent on the verification also shows an increase is surprising as the rules in 2023 have not changed significantly since 2016.

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67 Based on total emissions from stationary installations in 2023 taken from Article 21 reporting.

68 Evaluation of EU ETS Monitoring, Reporting and Verification Administration Costs, 2016

69 Data provided under Article 21 reporting

While the reported costs for competent authorities responsible for administering MRV procedures are higher than previous studies, with total cost estimates based on survey results are in a range of 7 – 13 million euro,[70] these are small relative to MRV costs for operators of stationary installations.

MRVA costs identified as an issue by both stationary installations and aircraft operators but, for most responding to the survey, they still represent a relatively small proportion of the overall ETS compliance costs. The difference in costs between different types for stationary installations reflect the complexity of the industrial process covered and the level of emissions. Installations in the chemicals, oil refining, and cement sectors generally incur per installation costs above the average. This is likely attributable to the greater complexity of processes and/or higher emission levels typically associated with these sectors. The MRVA requirements for installations in these areas account for both the complexity and scale of operations to ensure accurate emissions reporting and uphold environmental integrity. Using a standard cost approach, the cost per tonne of CO_2 for refining and cement sectors are on the lower side because of the higher emissions. Minerals and glass and pulp and paper report relatively high costs per tonne of CO_2. In pulp and paper, there are a high percentage of installations that use biomass (50% and 29% respectively)[71], which adds complexity to the MRV processes due to the need to demonstrate compliance with the sustainability and greenhouse gas savings criteria laid down in the RED II Directive.

Smaller installations bear relatively higher costs per unit of emissions than the larger installations, despite efforts to simplify requirements for these installations. The smallest installations report relatively high equipment costs. The costs per tonne of CO_2 decrease as the size of the installation increases, with small installations reporting particularly high costs per tonne. This was also found in the 2016 report on administrative costs, with Category A installations facing costs per tonne CO_2 around 50 times that of Category C.[72][73] In the current study, the difference between these two categories is about the same or narrower depending on the approach taken in the estimates. Over the years several measures were taken to simplify the monitoring requirements for the smaller installations whilst ensuring the environmental integrity and robustness of monitoring and reporting. Installations of low emissions can apply less strict monitoring requirements in accordance with Article 47 of the MRR. Category A installations are not required to meet the highest tiers. Conditions have been included in legislation to allow to waive site visits for smaller and simple situations with low verification risks. All these measures, including the increased use of templates, IT systems and guidance, have facilitated the implementation of MRV and made the system more effective. Nevertheless,

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70 There are 31 competent authorities, 27 Member States plus Iceland, Liechtenstein, Northern Ireland and Norway. The competent authority in Liechtenstein is not very active as only two installations were included in the EU ETS in the period 2021-2023. In the fourth trading period these installations are no longer in the EU ETS.

71 European Commission: Directorate-General for Climate Action, 2024. "Application of the European Union Emissions Trading Directive – Analysis of national responses under Article 21 of the EU ETS Directive (reported data in 2023)", Publications Office of the European Union, https://data.europa.eu/doi/10.2834/662983662983

72 Category A includes installations with emissions lower than 50 000 tonnes of CO2eq. A sub-set of this category are installations with emissions below 25 000 tonnes of CO2eq, called installations with low emissions. Category B includes installations with emissions more and equal to 50 000 and less and equal to 500 000 tonnes of CO2eq. Category C includes installations with emissions higher than 500 000 tonnes of CO2eq

73 Evaluation of EU ETS Monitoring, Reporting and Verification Administration Costs, 2016

smaller installations still report higher costs: to some extent because of the use of biomass, or because smaller installations do not always have simple monitoring requirements or robust MRV procedures.

Stakeholders in the EU ETS feel that efficiency in the MRVA system could be improved and brought forward ideas, through the survey, interview and the reality check workshop. Most of these suggestions for improvement related to the free allocation process as allocation benchmark rules are perceived to be complex and require often additional costs.

The options for improvements and streamlining related to the MRV of emissions identified by respondents to the survey and OPC broadly fall into the following categories:

- Changes to the requirements for site visits for verification.
- Changes to deadlines of reporting and less frequent verifications.
- Greater harmonisation on interpretation of materiality risk.
- Harmonising EU ETS/RED/Waste Framework Directive requirements.
- Standardised opt-out provisions
- Less strict MRV requirements for installations that have stable emissions and strong compliance records.
- Relaxing requirement on monitoring accuracy.
- Further simplifications for small installations.
- More timely provision of guidance and templates.
- More streamlining with the Industrial Emissions Directive (IED).
- Greater consistency in templates and IT tools across jurisdictions.
- Better alignment between EU ETS and CORSIA.
- Simplification of procedures for competent authorities.

While potentially providing some efficiencies, many of the options have implications for environmental effectiveness or legal/practical implications that need more consideration. The MRVA system has already been streamlined and simplified as it has developed, motivated by increasing cost efficiency but also improving equal treatment. Nevertheless, there are likely still further opportunities for improving efficiency that could be considered. Both survey and consultation results from the ETS and MSR evaluation indicate that Phase IV reforms strengthened traceability and consistency, but stakeholders felt that it did not totally deliver on simplification, leaving administrative burden a key concern for future MRVA improvements.

From the suggested improvements no options stand out as priorities for regulatory change within EU ETS, but some need more consideration as to whether they might be incorporated in regulatory change in future or whether other actions, such as clarified guidance or additional training, are needed. These include:

- Simplifications in the requirements for installations emitting less than 50 kilotons CO_2 with very simple monitoring methodologies and low inherent and control risks. Most simplifications are already accommodated in the Monitoring and Reporting Regulation and low risks in simple and small installation often require less extensive verification approaches.
- Simplification of uncertainty requirements smaller source streams and allowing a wider application of default values for the emission factors and calorific value for certain fuels. Generally, the current MRR already allows simplification on uncertainty assessment and the application of default values for commercially standard fuels. But further research may reveal additional opportunities for simplification.

- Further streamlining procedures or reporting requirements between IED, EU ETS and other legislation, regarding the reporting requirements to avoid overlap in reporting data.
- Simplification through digitalisation. Digital technology is already being used to improve efficiency and accuracy but there is still untapped potential. Various tools have been developed and implemented to help improve efficiency of the MRVA system and increase the accuracy of reported data. Templates have been developed by the European Commission for monitoring plans, emission reports, verification reports and improvement reports (for installations and aviation).[74] Additionally, the European Commission has developed an IT tool called ETS Reporting Tool MRV (ERT), designed to facilitate the submission of monitoring plans, emission reports, verification reports, and improvement reports. This tool helps streamline reporting to reduce administrative burden and improve the accuracy of reporting and increase compliance of installations. The ERT is a web-based platform offering advanced features for all stakeholders and applies to sectors covered by the EU ETS.[75] In the survey, around half of the competent authorities responding have implemented the ERT. Of those that have more than half reported that it had improved efficiency and quality of reporting significantly or slightly. Fewer competent authorities in the survey reported having developed their own IT system but those that had reported that it had improved efficiency

4.1.1.2.4 Has the auctioning system been an efficient way of allocating ETS allowances?

The auctioning system for ETS allowances is considered a more efficient way of allocating allowances, especially when compared to free allocation. Auctioning provides a market-based approach that ensures allowances are allocated to those who value them most, reducing risks like over-allocation and windfall profits. Additionally, auctioning generates revenues for governments that can be utilized for climate change mitigation and adaptation efforts. It has shown effectiveness in reducing emissions more significantly than free allocation, due to stronger incentives for companies to invest in abatement measures. Another advantage is the reduction of market manipulation and enhancement of transparency, essential for a functional emissions trading scheme. Despite administrative and financial resources required for auctioning, such as selecting the auction platform and managing procedures, it is less resource-intensive compared with tasks associated with free allocation, like setting benchmarks and reporting activity levels. The differences in auction clearing prices compared to secondary market prices have been minor, indicating competitiveness of the auctioning process. Overall, auctioning has successfully adapted to changing requirements and increased revenues for environmental initiatives. Though SMEs face participation barriers due to costs, they can access allowances through intermediaries or the secondary market.

4.1.1.2.5 Has the Registry system been operating in a cost-efficient way?

The Union Registry displays robust operational efficiency supplemented by security measures. However, it faces ongoing challenges due to evolving cybersecurity threats and resource limitations. Recommendations have been made to enhance security measures and reconsider

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[74] European Commission, "Monitoring Reporting and Verification". https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/monitoring-reporting-and-verification-eu-ets-emissions_en#tab-0-1

[75] Ibid

its business model to better align with financial market frameworks to ensure the integrity of the European carbon market.

The Registry system's cost efficiency can also be evaluated based on the fees charged by Member States and the annual costs of operating and maintaining the Registry incurred by the Central Administrator (European Commission). Overall, the Registry system has significant variations in fees across Member States and insufficient resources to protect the confidentiality and integrity of the system by the Central Administrator. Different studies proposed a new operating model to address these issues, with an estimated investment of EUR 32.8 million per year. This investment represents only 0.00016% of the assets held in the Union Registry and would ensure the integrity and security of the system and integrity of the European carbon market.

4.1.1.3 Coherence

4.1.1.3.1 To what extent is the Directive coherent with other EU policies, such as those related to renewable energy, energy efficiency, state aid, etc.?

The EU ETS has evolved to improve coherence both across EU instruments and within its own regulatory architecture, although some tensions remain. Externally, complementary EU-level policies such as the Renewable Energy Directive (RED) and the Energy Efficiency Directive (EED) have contributed significantly to decarbonising the power sector, which is one of the ETS's main coverage areas, by reducing fossil fuel-based electricity generation and overall energy demand. While these outcomes align with the broader objective of emissions reduction, in practice these overlapping policies have also undermined the ETS price signal by reducing demand for ETS allowances, especially prior to the reform of the ETS cap adjustment mechanism. This exposed to a degree of external incoherence, where complementary policies aimed at a common goal (emissions reduction) operated in ways that were not fully integrated with the market logic of the ETS.

The 2018 revision addressed overall coherence through the integrated modelling that underpinned the 2030 climate and energy framework. The Impact Assessment supporting Directive (EU) 2018/410 used modelling to test combined policy scenarios for GHG reductions, renewable energy, and energy efficiency, ensuring that the ETS cap and trajectory and allowance supply mechanism were consistent with parallel objectives in the RED and EED. The scenario identified as the most coherent, which combines a 40% GHG emissions reduction target with moderate renewables and energy efficiency measures, was found to deliver the targets at the lowest macroeconomic cost in terms of GDP.

The introduction of the MSR in 2019 helped to address the long-criticised waterbed effect by allowing allowance supply to respond to changes in demand, including those induced by overlapping policies like RED and EED. In principle, this enables real emissions reductions by cancelling unused allowances. Moreover, by linking the volume of auctioned allowances to the total number of allowances in circulation (TNAC) and introducing automatic invalidation of persistent surpluses, the post-2018 system allows the effective supply of allowances to adjust to market conditions and to policy-driven changes in demand.

However, as argued by Willner & Perino (2022)[76], the MSR has introduced new layers of complexity: while it responds effectively to unforeseen shocks, its interaction with anticipated

[76] Willner, M., & Perino, G., 2022. "Beyond Control: Policy Incoherence of the EU Emissions Trading System". *Politics and Governance, 10*(1), 256-264. https://doi.org/10.17645/pag.v10i1.4797

policy changes can dampen abatement incentives in the short term and complicate predictability. Overall, coherence has improved since 2018, but the system's dynamics have become more intricate, underscoring the importance of maintaining transparency in the MSR functioning and periodically reviewing its parameters to ensure continued effectiveness and coherence.

In the Open Public Consultation, respondents were asked to express their view on the external coherence of the EU ETS and MSR. Most respondents agreed that the EU ETS and MSR were coherent, to varying extents. Nevertheless, feedback from the stakeholder consultation stressed that, despite reforms such as the MSR and updated free allocation rules, ensuring both internal and external coherence remains a continuing challenge, particularly in relation to interactions with other EU climate and energy policies, and international frameworks.

4.1.1.3.2 To what extent are the various elements of the Directive (such as free allocation, carbon leakage, innovation support) coherent with one another?

Internally, the Directive has made efforts to balance environmental integrity with competitiveness and fairness. A key example is free allocation, which, while a deviation from the polluter-pays principle, remains justified as a transitional measure to address the risk of carbon leakage. Although free allocation might weaken the carbon price signal by preventing operators from being fully exposed to the carbon price, more targeted allocation based on updated benchmarks and declining free allocation shares have improved its internal coherence. In this way, free allocation can be understood not as a contradiction to the ETS logic, but as a pragmatic safeguard that supports the broader policy goals of EU climate leadership and industrial resilience. Similarly, the MRVA framework enforces internal coherence by ensuring that emissions are measured accurately, transparently, and homogeneously across all sectors and Member States. This high level of data integrity is essential to maintain trust in the cap-and-trade system, as it ensures that allowances correspond to real-world emissions, and that policy adjustments are based on verifiable outcomes. In this sense, the MRVA is not just a technical pillar to the ETS, but a central element that enables the system to effectively meet its climate objectives effectively.

Auctioning and the use of auction revenues are key elements supporting internal coherence. Auctioning reflects the polluter-pays-principle and ensures that carbon costs are internalised by operating firms, while the revenues generated complement free allocation. These revenues finance instruments such as the Innovation Fund (Article 10a(8)), which supports investment in industrial decarbonisation and low-carbon technologies, the Modernisation Fund (Article 10d), which supports the modernisation of energy systems and the improvement of energy efficiency of the lowest-income Member States. Together, these mechanisms support a coherent package of incentives for innovation and decarbonisation, and safeguards to support competitiveness, therefore reinforcing the objective of cost-effective emissions reduction of the ETS.

4.1.1.3.3 To what extent is the Directive coherent with international climate policies and obligations?

In terms of alignment with international objectives, the EU ETS is explicitly framed as a central instrument for achieving the EU's commitments to the Paris Agreement, including its NDCs (Nationally Determined Contribution). While the EU ETS is the central tool for reducing emissions in power, industry, aviation – which together account for around 40% of EU's total GHG output – its scope during the evaluated period did not cover emissions from maritime,

buildings and road transport, land use, and agriculture. Indeed, the ETS alone was not designed to deliver on its own the EU's full climate ambition, including the 2030 target of at least 55% emission reductions and the goal of climate neutrality by 2050. Additional policies such as the Effort Sharing Regulation, the introduction of the maritime sector in the EU ETS, and a newly approved second ETS (EU ETS 2), which will cover buildings and road transport from 2028, have been developed or are already in place. Together, these instruments are intended to form a more comprehensive and coherent policy framework capable of supporting the EU's 2030 targets and the longer-term objective of climate neutrality by 2050.

4.1.2 Market Stability Reserve

4.1.2.1 Effectiveness

The evaluation of the effectiveness of the MSR focuses on how successful the instrument has been in achieving and progressing towards its objectives. It uses where possible quantitative analysis complemented by qualitative assessments from existing studies and academic literature as well as stakeholder interviews. The evaluation focuses on two aspects of effectiveness: whether the MSR achieved its objectives, considering effectiveness in a broad sense; and, evaluating effectiveness in a narrow sense, it compares the expected effects of the instrument against the actual effects and developments in the EU ETS. Expected effects are those identified in the MSR Impact Assessment (IA) from 2014 for the years 2013 to 2017. For the years following the 2018 reform, the evaluation draws from the 2021 MSR Review. For a detailed outline of MSR reforms and a discussion of the suitable points of comparison, see Section 2.2.

In addition, the invalidation mechanism introduced in 2018 and reforms under the Fit for 55 package is also evaluated, as well as the price developments over the evaluation period together with price drops related to shocks and other events, assessing the role of the MSR for long- and short-term price changes. Closely related to the development of price is the question of how the MSR has been able to increase confidence in the allowance market, the EU ETS as instrument and the regulatory commitment of the EU and the Member States to a strong carbon market. This question is evaluated in the same subsection.

4.1.2.1.1 Achievement of objectives

4.1.2.1.1.1 Approach of evaluating achievement of objectives

Effectiveness in a broad sense evaluates whether the MSR has achieved its stated objectives. The first specific objective of the MSR is to reduce the excessive historical surplus that built up before the adoption of the MSR. The starting year of the evaluation is 2012, i.e. the base year of the 2014 IA, which featured a calculated TNAC at the end of the year of 1,750 million EUA. Of these, 917 million EUAs, i.e. the volume above the MSR's upper threshold of 833 million, can be considered as excess historical surplus. The MSR was effective in achieving its first objective if it reduced the TNAC by this volume.

The second specific objective of the MSR is to mitigate the build-up of any new surplus caused by supply and demand imbalances. For the effectiveness evaluation, an undesired build-up is defined as any increase of the TNAC from 2013 onwards. The second objective targets supply and demand imbalances in general, i.e. not just situations in which supply exceeds demand in response to unforeseen events or shocks but also situations of exceptional scarcity in which demand exceeds supply. As there is not yet a situation of the latter type of imbalance in the market, the evaluation focusses on the build-up of TNAC between 2013 and 2024 and how the MSR was able to mitigate this.

To assess the effects of the MSR on the TNAC and the achievement of the second objective, the actual TNAC is compared to an ex-post baseline, a simplified hypothetical counterfactual scenario without the MSR constructed after the fact. For this purpose, the operational MSR intakes[77] of each year are added to the reported TNAC, re-adding the supply that has been reduced because of the MSR (see Figure 11 below). This approach, however, neglects any dynamic effects of the MSR on the allowance demand, i.e. the verified emissions, and in turn on MSR intake and allowance supply in individual years. A strengthened EUA price or increased scarcity in the market would be expected to result in reduced emissions and hence allowance demand. This then would increase the TNAC and MSR intake. In consequence, the ex-post baseline overestimates the TNAC in the absence of the MSR and hence MSR effectiveness. However, this dynamic effect on allowance demand is unlikely to be dominant, and the ex-post baseline can be considered the robust way to assess the effect of the MSR on the TNAC.

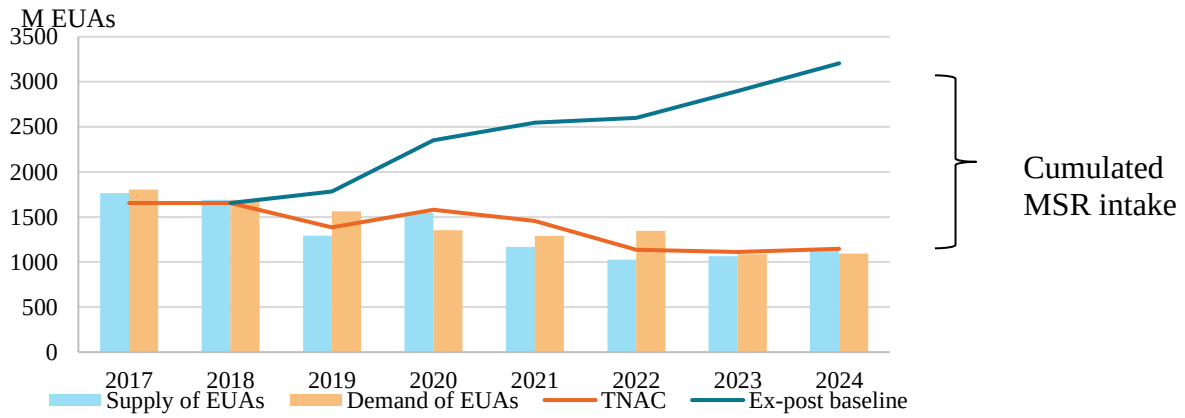
4.1.2.1.1.2 Development of demand, supply, and TNAC

As the objectives of the MSR focus on the number of allowances in circulation, this section starts with a description of demand and supply of allowances in each year after the baseline year 2012 to assess how the TNAC, which is the accumulation of supply and demand imbalances over time, has developed. For each year, main regulatory and economic events that influenced supply or demand are explained. Figure 11 shows the annual figures for demand and supply of allowances and the development of the TNAC[78]. It also presents the ex-post baseline as point of comparison of the MSR effects. Between 2012 and 2018, before the start of the MSR operations in 2019, the TNAC decreased from 1,750 to 1,655 million EUA (in part due to backloading). From the start of the MSR to the end of 2024, TNAC decreased to 1,148 million EUA.

[77] The official MSR intake as published in the annual TNAC Communications refer to an intake from September of a year t+1 to August in t+2 for a TNAC in year t. We use the term operational MSR intake as the intake for a calendar year.

[78] Note that the evaluation focuses on emissions from and allowances used by stationary installations only as the TNAC is based on these, leaving aside allowance supply and verified emissions for aviation.

Figure 11: Demand, supply[79], and TNAC from 2017 to 2024.



Source: Own illustration

There are no official TNAC announcements for the period 2013-2016 and so this period is not included in the figure above. However, apart from 2013, verified emissions for stationary installations were higher than or at least at par with allowance supply in the EU ETS. That means, even before the MSR went into force, the number of banked allowances in the EU ETS was decreasing. In 2018, the TNAC was 95 million EUA lower than in 2012 after the following developments:

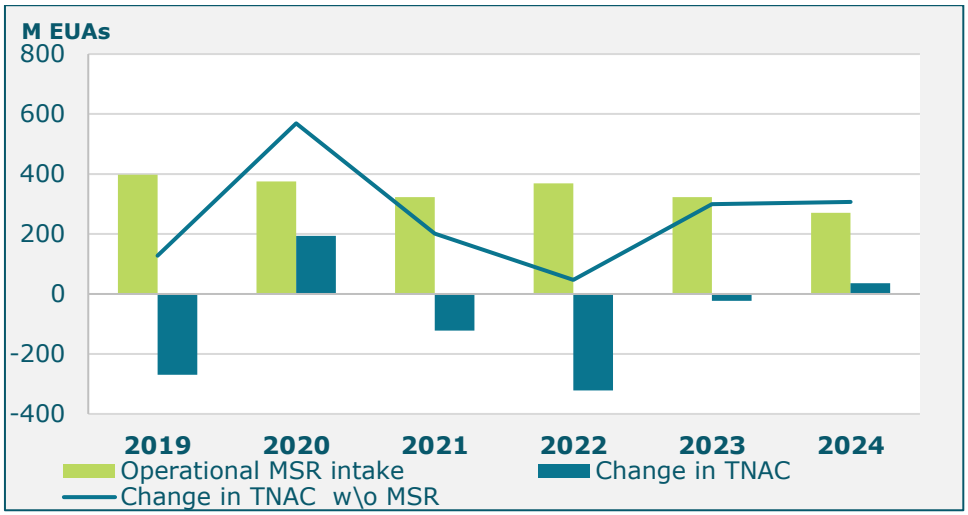
- One of the major contributors to the decrease in TNAC was the backloading of 900 allowances between 2014 and 2016. It is reasonable to assume that 2018 TNAC levels would have been above 2012 levels in the absence of this intervention. While the backloading of allowances did not have a noticeable effect on allowance prices, it was effective in reducing the surplus of allowances in the market.
- Another element that contributed to TNAC reduction was the decrease of offset inflow in the EU ETS. The rules for offset use for EU ETS compliance became considerably more stringent from Phase II (2008-2012) to Phase III (2013-2020). In Phase III, newly generated carbon credits were required to originate only from projects in least developed countries. Credits from industrial gas projects were excluded altogether, although carbon credits issued until 2012 could still be used for compliance in 2013 and 2014. (ICAP Status Report 2024) Hence, offset supply spiked in 2012 with 493 million credits, was still considerable in 2013 and 2014 (129 and 247 million credits, respectively) and dropped below 30 million credits for each year between 2015 and 2020.

In 2017, demand exceeded supply by 39 million EUA. In 2018, the difference between allowance supply and verified emissions was marginal. By then, allowance supply had dropped sufficiently to be at par with verified emissions without any additional cap adjustments. Verified emissions were relatively stable in this period, indicating the absence of any major demand shocks but also low progress on decarbonisation.

[79] Ex-ante supply is decreasing over time following the cap reduction. Ex-post supply reflects adjustments for e.g. MSR intake, Brexit from 2021, and scope expansion to the maritime sector from 2024.

The MSR started operating in 2019. Figure 12 below presents the operational MSR intake, the resulting change in TNAC as well as a hypothetical change in TNAC in the ex-post baseline scenario without the MSR. The latter is the sum of change in TNAC and MSR intake.

Figure 12: MSR intake; actual and ex-post baseline changes in TNAC



Source: Own illustration

This shows that in its first year and including an MSR intake of 367 million EUAs, allowance demand, i.e. verified emissions, exceeded supply by 269 million. It is very likely that the TNAC would have increased in the absence of the MSR (ex-post baseline scenario).

The pandemic year of 2020 brought an unanticipated demand shock which contributed to adding 194 million EUA to the TNAC, even in the presence of the MSR. This is caused by the restrained economic activity and a drop in verified emissions from 1,562 to 1,352 Mt EUA from 2019 to 2020. At the same time, EUA supply to the market increased from 1,293 to 1,546 Mt EUA when the suspended UK auctions and free allocations in 2019 were compensated for in 2020.[80] In total, the TNAC thus increased in 2020 despite an MSR intake of 376 million EUA. Part of this increase in TNAC occurred due to the shift of supply from 2019 to 2020, i.e. the TNAC decrease in 2019 would have been lower in the absence of this effect.

The following years 2021-2023 saw again a decline in TNAC (blue bars), with the help of MSR intakes above 300 million EUA per year (green bars). The years 2021 and 2022 featured similar levels of verified emissions as 2020. Here the economic recovery after the pandemic increased emissions but the withdrawal from UK entities from the EU ETS reduced them. Allowance supply was below verified emissions with the help of the MSR, leading to a considerable TNAC decrease. The Russian invasion of Ukraine in February 2022 and the energy price crisis led then to another economic downturn accompanied by a drop in verified emissions in 2023 and 2024. At the same time, verified emissions were at par with allowance supply, leading to marginal changes in 2023 and 2024, respectively.

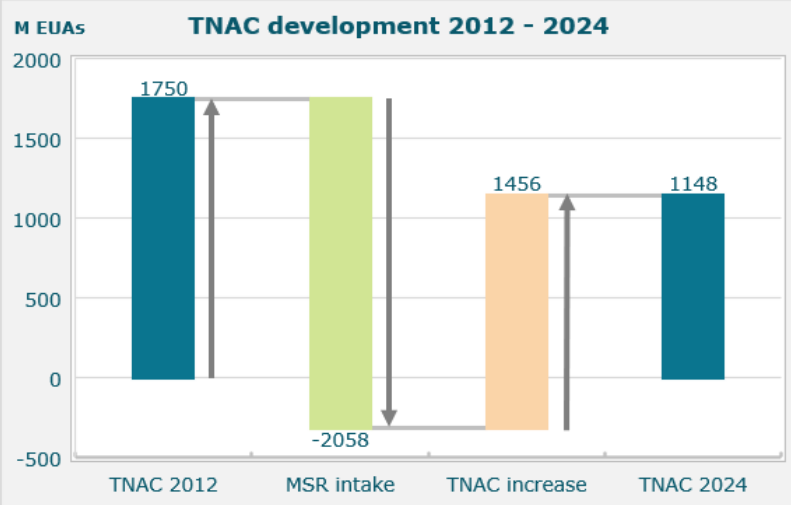
[80] DG CLIMA, 2020. "Lifting the suspension of UK-related processes in the Union Registry of the EU ETS, news article 31 January 2020", https://climate.ec.europa.eu/news-your-voice/news/lifting-suspension-uk-related-processes-union-registry-eu-ets-2020-01-31_en

4.1.2.1.1.3 Conclusion on historical surplus (until 2012) and new surplus (added between 2013 and 2024)

Considering the base year for this evaluation is 2012, the starting volume of TNAC is 1,750 million EUA. Given this starting value, everything above the MSR upper threshold of 833 million EUA was assessed as being excessive historical surplus. Hence, there was an excess historical surplus of 917 million EUA in 2012. Since the MSR started operating in 2019, its total operational intake until 2024 was 2,058 million EUA. This volume exceeded, together with the 900 million EUA from backloading in 2014 to 2016, the excess historical surplus by far. It can be concluded that the MSR successfully achieved its first objective of reducing the historical surplus in the allowance market.

The second objective of the MSR targets new surplus that built up between 2013 and 2024. From the perspective of 2012, this can be considered as future surplus. We can define additional surplus as any increase in TNAC, resulting from an imbalance of demand and supply over the evaluation period. Figure 13 below shows how in aggregate the MSR intake of 2,058 million EUA exceeded the initial TNAC of 1,750 million EUA. However, the TNAC would have increased by 1,456 million EUA in a simplified ex-post baseline scenario, leading to an actual TNAC in 2024 of 1,148 million EUA. In other words, the MSR intake did not fully cover the new demand-supply imbalance that built up between 2013 and 2024, as the TNAC of 1,148 million EUA in 2024 was still above the targeted level of 833 million EUA. While the significant drop in TNAC since 2012 is a success, it did not fully tackle subsequent demand-supply imbalances. In consequence, the MSR achieved its second objective albeit only partially.

Figure 13: Aggregate development of TNAC between 2012 and 2024



Source: Own illustration

Part of this overall success needs to be attributed to the backloading of 900 million allowances between 2014 and 2016 that were later transferred to the MSR and subsequently invalidated. The backloaded allowances consequently did not return to the market, as initially planned. Without this measure, the build-up of new surplus would have been higher.

Looking at individual years, apart from 2020 and 2024 since the MSR entered into force, the operational MSR intake exceeded the reduction in TNAC. It is hence likely that without the MSR, the TNAC would have increased in these years, so the demand-supply imbalance would

have increased. With the MSR, TNAC levels decreased, although the target level of 833 million has not been reached yet.

In a counterfactual baseline, allowance supply was still above verified emissions between 2019 and 2024. It is likely that emissions reductions induced by climate policy measures (e.g. an increase of renewable capacity) and unanticipated demand shocks (e.g. economic downturns) reduced verified emissions by more than the amount that the Linear Reduction Factor has reduced the cap over the same period. When supply exceeds demand in a given year, by construction the MSR only removes a part of the imbalance (i.e. 24% with the current intake rate) as long as it is outside the buffer zone. Once the TNAC is between 833 and 1096 million EUA, all new surplus is transferred to the MSR which ensures per construction full effectiveness. Above the buffer zone, the MSR is by design delayed in its effectiveness and as long as TNAC builds up the MSR can only be partially effective in addressing demand-supply imbalances.

4.1.2.1.1 Comparison of actual outcome to baseline assessment

4.1.2.1.1.1 Approach for evaluating actual versus expected MSR effects

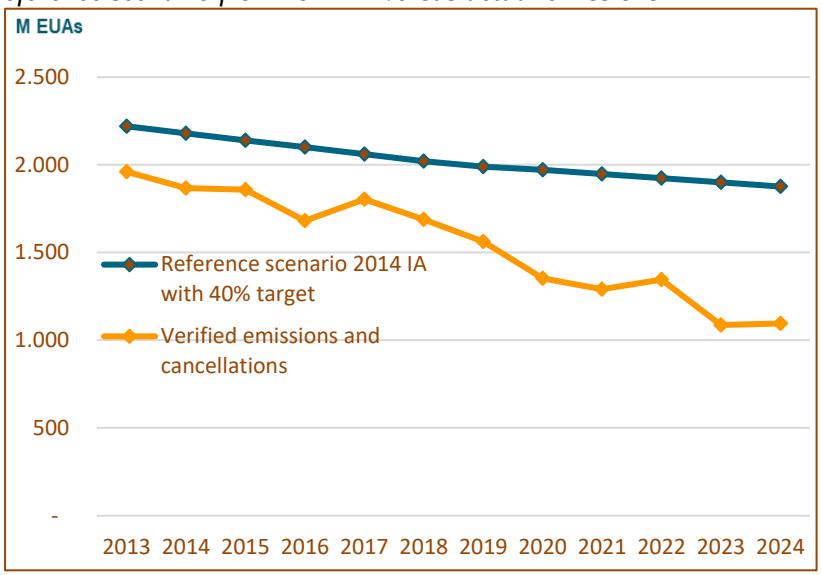
The second part of the effectiveness evaluation analyses if the effects of the MSR occurred as expected when the mechanism was designed in the early 2010s and whether unforeseen developments or unintended effects leading to a higher or lower TNAC or to the MSR behaving in a different way have since occurred. For this, actual EU ETS data should in theory be compared to a baseline describing a scenario set up before the adoption of the instrument.

The main baseline should in general come from the impact assessment of a policy. In this case, the Commission undertook an impact assessment for the MSR in 2014. It modelled different scenarios and options for the adoption of the MSR described in Section 2.2. The next section compares actual market outcome in the period from 2014 to 2017 to the assessment of Option 2d in the IA (with MSR start in 2017 and 2021). Because of the substantive reforms between 2018 and 2023, the design of the MSR has changed considerably. This makes it impossible to identify a suitable point of comparison in the 2014 IA to evaluate the MSR performance in the years 2018 to 2024. Instead, the evaluation will draw upon other existing analyses, particularly the MSR Review in 2021, as points of comparison. Section 4.1.2.1.2.3 compares the market outcome of 2021 to 2024 to the scenario in the 2021 MSR Review which hence serves as an alternative point of comparison.

4.1.2.1.1.2 Comparison of actual outcome to baseline from 2014 Impact Assessment

While the scenarios modelling the MSR options from the 2014 IA are not helpful for evaluating the MSR that has been implemented in 2019, the IA offers several important insights on the expected effects of the MSR and thus helps evaluating its conception and identifying where assumptions in 2013/14 did not turn out to be valid. One example is the reference scenario used in the IA.

Figure 14: Reference scenario from 2014 IA versus actual emissions



Source: Own illustration

The reference scenario from the 2014 Impact Assessment presents a scenario that fully implements all existing policies, including backloading, renewable energy targets, emission reduction targets for 2020 (20%) and 2030 (40%) and the implementation of the Energy Efficiency Directive. It depicts a world without the MSR that is more ambitious regarding the implementation of climate policies compared to the 2014 IA baseline scenario (IA 2014, p. 8ff.). The reference scenario is hence a better point of comparison for the evaluation than the baseline scenario, as it is closer to the actual EU climate policy ambition in the evaluation period.

Figure 14 compares the emissions profile under the reference scenario with the actual verified emissions (incl. a small number of voluntary allowance cancellations which are accounted for together). It is striking that the emissions path from the reference scenario significantly overestimates emissions in the EU ETS. In 2024, emissions were around 45% below the expectations in the reference scenario. That means, emission reductions were much higher than expected. This likely results from a combination of three types of unanticipated developments: First, the expectation of increased ambition of the EU ETS in the lead up to the adoption of the European Climate Law and the Fit for 55 package led to a stronger signal for emissions reductions through an increased EUA price already in 2018 (see subsection on prices below).The expectation was then confirmed when the higher linear reduction factors were implemented in 2021 and 2024. Second and related to increased ambition, other climate policies to decarbonise the EU ETS sectors, especially in the power sector, reduced emissions more than expected. Third, political and economic events like Brexit, the COVID-19 pandemic and the energy price crisis reduced emissions significantly. Note that even in years of high economic activity (e.g. in 2015 or 2018), emissions declined more than expected. The 2021 MSR Review calculates that the annual cap decline rate between 2013 to 2019 was 1.95%, compared to a decline of verified emissions of 3.57%, attributing this mainly to policies inducing a decrease in emissions from electricity and heat (Vivid 2021, p.35). In a way, this positive development of unexpected emissions reduction contributed to the fact that there is still a remaining demand-supply imbalance in the EU ETS.

It is important to underline that the objective of the MSR is to strengthen and stabilise the EU ETS but not necessarily to increase its ambition. If the MSR contributed to strengthening

confidence into the EU ETS and supporting EUA prices, it led to lower verified emissions thereby potentially reducing its own activity. Because emissions levels decreased and are below the allowance supply even in 2024, TNAC levels are still above the MSR upper threshold of 833 million EUA and hence the MSR only partially achieved its second objective. For the 2014 IA, it can be concluded that the reference scenario underestimated the problem to be addressed by the MSR and in consequence expected a more pronounced MSR effect.

Figure 3 in the 2014 IA shows the expectation that both allowance supply and demand will decline at a relatively low rate in the reference scenario with demand exceeding supply from 2022 and the total surplus accordingly increasing slowly until 2022 and decreasing afterwards (see 2014 IA, p. 9). The focus of the MSR design was in consequence on the excess historical surplus and not on future demand-supply imbalances. However, both demand and supply decreased at a faster rate than expected. The latter materialised through an increase of the Linear Reduction Factor from 1.74 to 2.2 in the 2018 reform and to 4.3/4.4 in the Fit for 55 reform. Both effects increased the relevance of future demand-supply imbalances compared to the excess historical supply. The starting point for the 2014 IA did not consider these unexpected developments.

As a result of the overestimation of verified emissions in the reference scenario, the actual TNAC was higher than in the modelled scenarios from the 2014 IA – in the range of 15% to 20% for the years 2014 to 2016. For 2017, TNAC is around 1,450 million EUA if the MSR is implemented in Phase III (2017) and 1,550 million EUA if in Phase IV (2021) in the Option 2d scenario that serves as a point of comparison for this evaluation. When the MSR started operating in 2019, the actual TNAC was 1,655 million EUA. This was even though the implemented intake rate at 24% was higher than what was proposed by Option 2d (100 million EUA if TNAC is above 1,000 million EUA, i.e. ≤ 10%). The observed TNAC remained high despite the relatively low prices between 2013 and 2017 which imply a low incentive to reduce emissions and in consequence high verified emissions. Both reduce the TNAC at a given level of allowance supply. These were the circumstances under which the MSR became operational in 2019.

Note that MSR elements can take effect long before they become operational as each reform changes expectations of EUA prices and in consequence mitigation behaviour. The MSR likely had an effect before it entered into operation in 2019. This effect was however not considered in the quantitative analysis of the 2014 IA. The modelled Option 2d with a start in 2021 should have display effects already in 2017 due to the anticipation of market participants. It is likely that the verified emissions and TNAC in 2017 were influenced by this anticipatory effect.

4.1.2.1.1.3 Summary of findings on MSR effectiveness from Vivid study for 2018-2024

As explained in the point of comparison analysis of the MSR above, the years 2018 to 2024 cannot be compared to the 2014 IA as the 2018 reform fundamentally changed the instrument compared to what was assessed in the IA. In the absence of a point of comparison, this evaluation draws on the conclusions from the 2021 MSR Review (SWD(2021) 601 final) based on a 2021 Vivid Economics study.

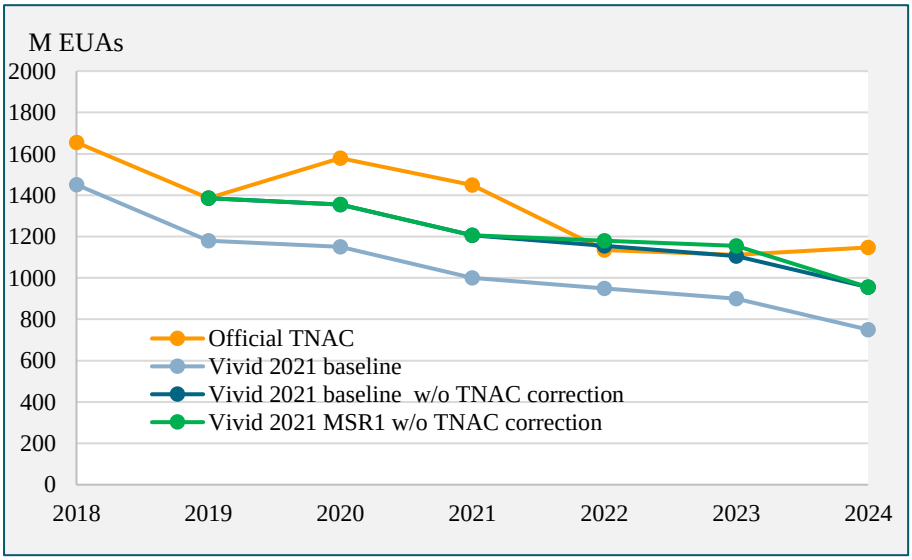
The 2021 MSR Review has two elements. First, a backward-looking perspective for the years 2018-2020 for which the review assessed how the MSR has performed drawing on the conclusion of the legal review (Annex 7 of SWD(2021) 601 final) as well as Section 3.2 in the study by Vivid Economics. In essence, the MSR Review confirmed the finding that the MSR successfully addressed the historical surplus, already in its first years of intake in 2019 and

2020. In line with this assessment, it identifies the overestimation of verified emissions as an obstacle to the reduction of TNAC to the target levels and hence to MSR effectiveness.

Second, the 2021 MSR Review has a forward-looking section modelling future scenarios of MSR developments given political and economic events and shocks. Chapter 4 and 5 of the Vivid Economics (2021) study discuss future risks for the MSR and design options to improve the functioning of the MSR which feed into an impact assessment of future MSR design in Annex 8 of the official MSR Review. The forward-looking analysis from the 2021 MSR Review can serve as alternative point of comparison for the evaluation of the years 2021 to 2024: the baseline scenario represents the MSR as implemented in 2019 based on the outcome of the 2018 reform.

The 2021 MSR Review raises the point that an inadequate TNAC calculation interferes with the MSR effectiveness (see Vivid 2021, 54ff.). It highlights that the net demand from aviation and linking with the Swiss ETS overestimates the TNAC, i.e. the number of allowances that are available to the market is lower than the calculated and published TNAC. In consequence, the Review infers that the MSR intake was higher than it would have been with a corrected TNAC. The study authors hence correct the TNAC start value in 2019 for the baseline scenario for their impact assessment (see Vivid 2021 baseline). As the official TNAC has not yet been corrected, the current analysis adjusted the modelling results from the 2021 MSR Review by adding a constant term that reflects the 2019 TNAC correction conducted by Vivid Economics (labelled as "w/o TNAC correction").

Figure 15: TNAC 2018 to 2024: Official data versus baseline and MSR1 from 2021 MSR Review



Source: Own illustration

The baseline and the MSR1 scenario in the 2021 MSR Review can serve as alternative points of comparison for the MSR evaluation (see Subsection 2.2 above for a detailed description of the modelled scenarios). Figure 15 presents the official TNAC and the modelled TNAC for the years 2018 to 2024. For the years 2020 and 2021, the effect of the COVID-19 pandemic leading to reduced verified emissions is visible. In consequence, the model results underestimate the TNAC significantly.

A similar phenomenon can be observed for 2024. In response to the energy price crisis and the induced economic downturn, as well as high levels of electricity from renewable energy sources, verified emissions decreased significantly in 2023 and 2024. This led to an increase

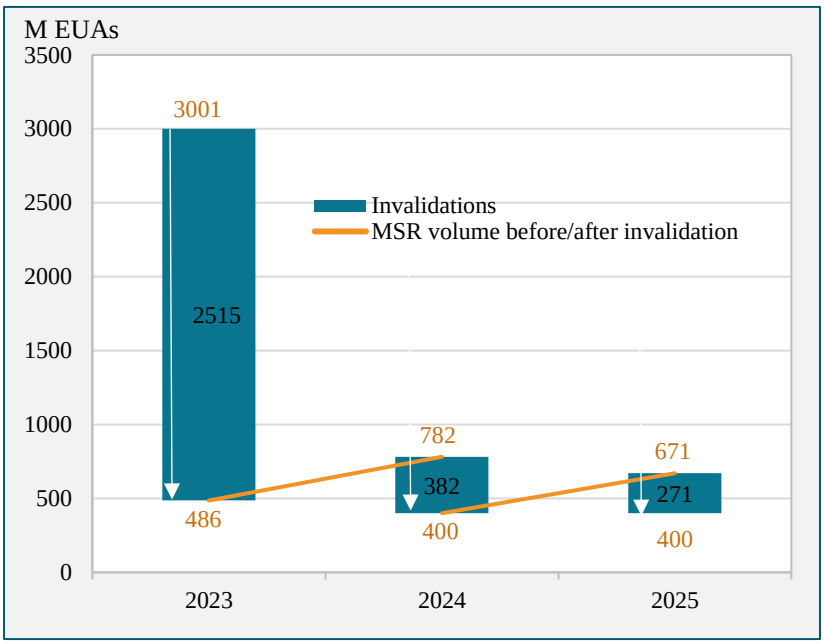
in the TNAC that was unexpected from the perspective of the 2021 MSR Review. The model results match the actual TNAC in 2022 and 2023. In 2022, the economic recovery after the pandemic matched expectations of such recovery. Note that the modelling results lead to the dynamic effects of an increased TNAC in 2022 and 2023 in the MSR1 scenario (green line) compared to the 2021 MSR Review baseline (blue line). Because market entities anticipate an MSR reform to be implemented in 2024, prices increase even before that reflecting this anticipation, leading to earlier emissions reductions and in consequence a higher TNAC.

4.1.2.1.2 Effectiveness of invalidation mechanism

As described previously, the 2014 Impact Assessment did consider introducing an MSR together with a permanent retirement of an absolute number of allowances from the backloading volume in Option 3. However, the in 2015 adopted MSR did not include comparable design features and opted for a cap-neutral mechanism, limited to shifting allowance supply over time. Only in 2018, when the EU ETS required further strengthening, the adopted reform of the MSR included an invalidation mechanism, restricting the MSR volume to the auction volume of the previous year and invalidating all allowances above that threshold, starting in 2023. With the Fit for 55 reform, the threshold was then changed from a dynamic threshold to the fixed level of 400 million allowances that cap the MSR volume.

Option 3 in the 2014 IA is not a useful point of comparison for the implemented invalidation mechanism. The substantial difference is that the permanent retirement proposed in the IA envisioned a retirement of a fixed number of allowances (500 million EUA) at a fixed point in time (in 2019 and 2020) (IA 2014, p.37). The introduced mechanism in turn implemented an automatic, rule-based process for retirement without prescribing volume and timing (apart from the start year 2023). Accordingly, the scenarios in the 2014 IA cannot be compared to the actual invalidations. At the time of adoption in 2018, there was no impact assessment estimating the number of allowances that would be invalidated given the new mechanism. Only the 2021 MSR Review conducted by a consortium around Vivid Economics modelled scenarios for the impact of the invalidation mechanism that can serve as point of comparison for the evaluation. It analysed two concrete configurations in four scenarios: the scenarios *Baseline* and *MSR1* modelled the 2018 configuration of the invalidation mechanism, and *MSR2* and *MSR3* modelled invalidation above an MSR volume of 700 million EUA starting in 2024.

Figure 16: MSR volume and respective invalidations



Source: Own illustration

Figure 16 presents the MSR holdings before and after invalidations and the respective invalidation volumes in the three operational years of the invalidation mechanism. 3,167 million allowances were invalidated so far in 2023, 2024, and at the beginning of 2025. In 2023, the 2018 configuration of the invalidation mechanism was still in force setting the volume of invalidated allowances to the auction volume in the EU ETS in 2022. For 2024 and 2025, the new configuration had been adopted, invalidating all allowances above an MSR volume of 400 million EUA. Complementing the invalidation volumes, the graph shows how the MSR volume increases throughout the years as a result of additional MSR intake.

For 2023, the 2021 MSR Review estimated a lower invalidation of around 2,100 million EUA (against the 2,515 million EUA actually invalidated). The gap can likely be attributed to the expectation of an economic recovery after the COVID-19 pandemic that would have led to higher emission levels, a lower TNAC and in consequence less MSR intake and invalidations. Another part of the explanation might be that the 2023 configuration of the invalidation mechanism had an unintended self-amplifying effect: A high TNAC in 2021 led to more MSR intake in 2022. This in turn reduced auction levels and led to a higher invalidation volume.

The invalidations in 2024 and 2025 are in all scenarios of the 2021 Vivid study between 200 and 350 million EUA. Invalidations above a fixed MSR volume of 700 million EUA led to slightly lower invalidations compared to the 2018 configuration. Actual invalidation in 2024 was higher than in the modelled scenarios as the adopted 400 million EUA maximum MSR volume is more ambitious than the modelled 700 million EUA maximum.

While the exact figures of invalidation differ between actual market outcome and the 2021 MSR Review, the invalidation mechanism works as expected. It follows the set rules for a process of automatic invalidations which left by design no leeway for political or other interferences. The design as rule-based mechanism that, for instance, did not rely on further political approval before an invalidation takes place led to an effective mechanism that works as planned.

It is more difficult to assess the effectiveness of the invalidation mechanism in terms of achieving its set objective, mainly because the invalidation mechanism has no official standalone objective but must be evaluated as part of the MSR. In terms of the MSR objectives of reducing the historical surplus and preventing the build-up of future surplus, it can be pointed out that the invalidation mechanism did not have any direct effect on allowance supply up until now. The invalidation mechanism only reduces the allowances in the reserve and consequently the allowance supply in times in which the TNAC reaches the lower threshold of 400 million EUA. Only then, it limits the number of allowances that is released from the reserve and reinjected into the market and shortens the reinjection period. The invalidation mechanism will not have any direct effect on the number of allowances in the market before that. Note that the absence of direct effects, i.e. invalidations, until now does not mean that the invalidation mechanism has not been effective, as short-term direct effects were never intended.

There has been, however, an indirect effect of the invalidation on today's prices and abatement behaviour, which is difficult to assess quantitatively. The invalidation reduces cumulative allowance supply that will be available over the next decades in the EU ETS. This increases overall scarcity in the market leading to higher prices both in the future and today, if market actors have a sufficiently long planning horizon. However, this effect is relatively low compared to adjustments of the linear reduction factor (LRF), i.e. the general ambition of the EU ETS, which has a more immediate impact on the supply of allowances. Bocklet et al. (2019)[81] find that the increase of the LRF from 1.74 to 2.2 had a 4.5 times stronger effect on the overall allowance supply than the invalidation mechanism in the 2018 reform. However, the invalidation of 3,167 million allowances between 2023 and 2025 is equivalent to 23.4% of the allowances supply in Phase III (2013 to 2020) and hence not negligible.

The introduction of the invalidation mechanism induced a fundamental shift. While the 2015 MSR was potentially cap-neutral in the long-term (by allowing to shift the allowance supply across time for use in a later period), the invalidation of allowances meant an endogenous adjustment of allowance supply and a reduction of allowances available in the EU ETS. One of the strongest effects from the introduction of the invalidation mechanism was probably the one signalling that the EU was committed to a stringent and ambitious instrument, automatically, i.e. without the need of further political approval, invalidating excess allowances that could potentially weaken the market. As discussed above, the 2018 and the Fit for 55 reform were effective in providing a strong signal. Especially the 2018 reform showed that "*the doctor cared for the patient*" as some interviewed stakeholders put it. However, the reduction of EU ETS auction volumes was rated by 36% of stakeholders as the most important MSR feature contributing to the MSR's effectiveness compared to 11% that consider the invalidation mechanism to be the most important MSR feature.

4.1.2.1.3 Evaluation of price developments and market confidence

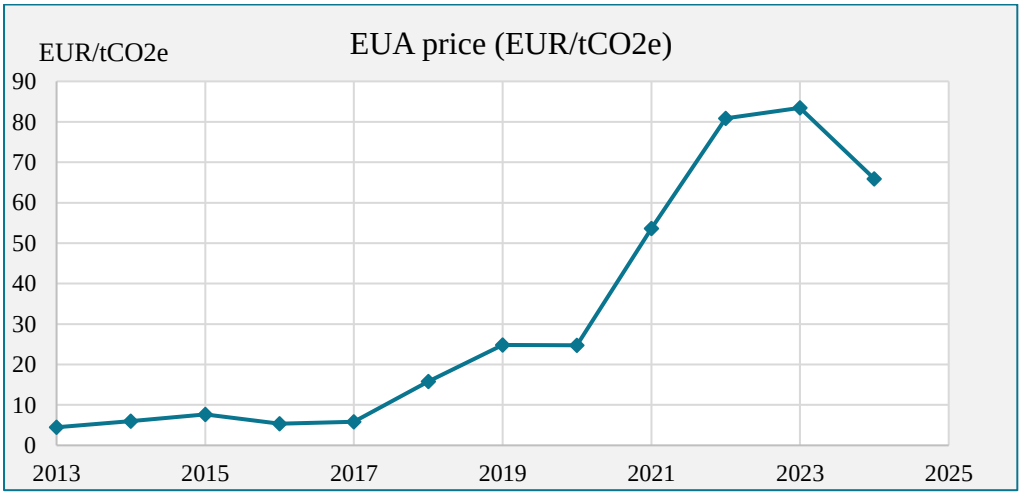
4.1.2.1.3.1 Annual price levels

While the emphasis of the MSR's second specific objective of enhancing future resilience of the EU ETS market is on preventing the build-up of new surplus, as discussed in the previous subsection, it also points to stabilising price developments and increasing confidence in the market. This subsection takes a closer look at these components of EU ETS resilience.

[81] Johanna Bocklet, Martin Hintermayer, Lukas Schmidt, Theresa Wildgrube, 2019. "The reformed EU ETS - Intertemporal emission trading with restricted banking", https://doi.org/10.1016/j.eneco.2019.104486.

Figure 17 shows the development of EUA prices over the evaluation period. Two periods can be distinguished. Between 2013 and 2017, EUA prices remained under EUR 10 . Hence, neither the discussions around the design of the MSR, the adoption of the MSR Decision in 2015 nor the backloading of allowances from 2014 to 2016 did lead to noticeable price increases that could be interpreted as an indicator of increasing confidence. Forward-looking market participants adjust their behaviour based on their expectations of future prices. If the market expected a price increase for 2019 (when the MSR became operational) already at the time when the MSR was announced or adopted, this would have had also an effect on prices at that time, i.e. in 2015. The reason is that EUAs can be banked, so it makes sense to buy them at a lower price in 2015 if prices are expected to increase in 2019. However, neither verified emissions nor price levels reacted strongly to the initial announcement of the MSR in January 2014 or its adoption in March 2015. This indicates that the market might not have expected the 2015 MSR to have a substantial effect. This can be partially explained by the fact that the initial MSR only shifted the supply of allowances to the future by reducing auction levels in the short run and increasing them at a later stage. The overall allowances supply did not change. This only changed with the introduction of the invalidation mechanism in 2018 which was further strengthened by the Fit for 55, reform, proposed in 2021.

Figure 17: Annual average EUA prices



Source: Enerdata

Another explanation why the MSR adoption in 2015 had no significant effect is the potential short-sightedness of market participants. Quemin and Trotignon (2021) modelled rolling horizons in the context of the EU ETS and concluded that a horizon of a 12 years can explain best the market behaviour between 2008 and 2017.[82] Similarly, Bocklet and Hintermayer (2020) find that a planning horizon of ten years explains best the EUA prices in Phase III.[83] While these horizons might suggest that an introduction of the MSR five years after its initial announcement can be foreseen even by shortsighted market participants, the exact mechanisms of myopia are not fully understood. Furthermore, carbon market analysts generally observe short-sighted behaviour from market participants in the carbon market.

[82] Quemin & Trotignon, 2021. "Emissions trading with rolling horizons", *Journal of Economic Dynamics and Control*, Volume 125, April 2021, 104099.

[83] Bocklet & Hintermayer, 2020. "How does the EU ETS reform impact allowance prices? The role of myopia, hedging requirements and the Hotelling rule". *EWI Working Paper*, 20/01.

Only with the 2018 reform that increased the Linear Reduction Factor and adjusted the MSR including the adoption of the invalidation mechanism, prices began to increase significantly. In 2018, price levels reached EUR 15.8 per tCO_2e, almost tripling compared to the EUR 5.8 per tCO_2e in 2017. Prices further increased to EUR 24.9 per tCO_2e in 2019, holding this level with an average of EUR 24.8 per tCO_2e during the pandemic year of 2020. Linked to the proposal of the Fit for 55 reform, prices increased substantially in both 2021 and 2022 to 53.7 and EUR 80.8 per tCO_2e, respectively. They remained high in 2023 with an average of 83.5 EUR per tCO_2e. Prices dropped toEUR 65.9 per tCO_2e in 2024, likely because of the economic downturn and, at the same time, record renewables that led to lower verified emissions in 2023 and 2024.

The 2018 reform and the Fit for 55 reform proposed in 2021 had a significant effect on EUA prices. Academic research using EU ETS modelling shows that the price increases can mainly be explained by the increased Linear Reduction Factor with the MSR reforms having only a small fundamental effect (see for instance Bocklet et al. (2019)[84] and Wildgrube (2023)[85]). However, several stakeholders mentioned in interviews that they perceive the MSR as part of a package, which increased confidence and strengthened market prices in the EU ETS.

The Vivid Economics (2021) study also confirms that the MSR and backloading helped restore EUA prices from low historical levels induced by a historical build-up of allowance supply. This is in line with the results from the open public consultation in which respondents frequently referred to the MSR and its effectiveness in addressing the structural surplus in the EU ETS as key factor for the increase of the carbon price (mentioned several times, especially by NGOs) as well as for the increase of market liquidity and mitigation of price volatility (mentioned especially by companies and business associations). The Vivid study acknowledges that the price increases cannot be only attributed to the MSR but to the broader set of EU ETS reform elements in 2018 (the study was completed before the Fit for 55 reform proposal).

4.1.2.1.3.2 MSR and price shocks

Part of the MSR's objective to increase the resilience of the EU ETS is how the MSR interacts with allowances prices in the presence of shocks and crises. During the five operational years that are subject of this evaluation, the MSR had several opportunities to prove its effectiveness in improving the resilience of the EU ETS against crises and shocks. We identify at least there major economic and policy shocks:

1. Brexit and the shift of UK's share of EUA supply from 2019 to 2020
2. COVID-19 pandemic in 2020/21
3. Energy price crisis in 2021 to 2023

The evaluation focuses on assessing if the MSR contributed to mitigating price crashes. For this, we need to look at price changes with higher frequency. We can potentially rely on the legal definition of undesired price developments from Article 29a of the ETS Directive. It refers to price increases in which the average price over a period of six months is 2.4 times higher than the preceding two-year reference period. The mechanism, however, looks at unexpected price increases instead of price crashes. The latter seems to be more short term in character. For the purpose of this evaluation, a price crash is defined as any substantial decrease of auction

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[84] Bocklet, Hintermayer, Schmidt, and Wildgrube, 2019. "The reformed EU ETS - Intertemporal emission trading with restricted banking". *Energy Economics*, page 104486.

[85] Wildgrube, 2023. "Fit for 55? An assessment of the effectiveness of the EU COM's reform proposal for the EU ETS". *Zeitschrift für Energiewirtschaft* 47, 52–65 (2023).

clearing prices within a one-month period. Section 4.1.1.1.2 presents more granular price graph showing such price drops.

The shift of supply of UK EUA from 2019 to 2020 did not lead to any visible repercussions on the EUA primary market. This probably indicates that, while supply of UK EUA was paused by the end of 2018 as a result of Brexit negotiations, there was confidence in the market that a transition would be handled carefully in case the UK would leave the EU ETS. In particular, a potential market disruption could have been caused by a temporary over- or undersupply of allowances in the EU ETS if UK entities still had to surrender allowances but supply of UK EUAs ceased or if surrender obligations phased out but UK EUAs were still supplied to the market. These scenarios seem to have been assessed as unlikely by the market participants. The shift of supply in itself is not problematic. Even short-sighted market participants would anticipate an increase in the following year and keep their market behaviour unchanged. From 2021 onwards, the exit of the UK from the EU ETS was permanently implemented with an adjustment of the supply of allowances (see Decision 2020/1722) and of the MSR intake (see Commission Notice 2020/C 428 I/01). From this moment, surrender obligations for UK entities also ceased.

The COVID-19 pandemic led to a price drop from EUR 24.64 per tCO_2e on 24 February 2020 to a low of 14.60 EUR/EUA on 23 March 2020, clearly related to the first lockdown and the uncertainties around the economic implications of the pandemic. Prices recovered by June 2020 and increased steadily over the remainder of the pandemic, reaching the milestone of EUR 50 per tCO_2e in May 2021.

The energy price crisis from 2021 to 2023 saw significant price drops within a month on two occasions after a period of sustained price increases after the announcement of the Fit for 55 reform proposal. Most notably, the auction price decreased from EUR 97.51 per tCO_2e on 8 February 2022 to EUR 57.91 per tCO_2e as a result to the Russian invasion of Ukraine on 24 February 2022. The price recovered over the summer to see another price drop from EUR 97.50 per tCO_2e on 22 August 2022 to EUR 65.21 per tCO_2e on 9 September 2022 related to high gas prices after the shutdown of the Nord Stream 1 pipeline in late August and its final closure in September 2022.[86] In the power sector high gas prices tend to induce a shift to coal-fired power generation, leading to higher emissions and hence higher demand and EUA prices. In August/September 2022, the expectation of market participants seems to have been rather a downturn of industrial production in response to the high gas prices, leading to lower emissions and EUA prices. This price drop was potentially exacerbated by speculations around potential political interventions to relieve pressure from high energy prices by increasing allowance[87] The Commission requested the European Securities and Markets Authority (ESMA) to conduct an in-depth enquire into the trading of emission allowances. This enquiry did not find any major issues as regards the transparency and integrity of the trading emission allowances that ETS prices reflect market fundamentals[88].

A second related price drop took place between 16 November and 15 December 2023 where prices decreased from EUR 79.00 to EUR 66.60 per tCO_2e. Analysts attributed this price drop

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86 See for instance https://www.politico.eu/article/gazprom-announces-nord-stream-stoppage/.

87 Carbon Pulse, 2022. "Euro Markets: EUAs slide to six-month low amid prospect of additional supply", 5 September 2022, https://carbon-pulse.com/171157/.

88 European Securities and Markets Authority, 2022. "Final Report on EU emission allowances and derivatives thereof", ref ESMA70-445-38, 28 March 2022.

to be predominantly caused by additional auctioning to finance REPowerEU.[89] The REPowerEU strategy was designed to reduce energy dependence from Russian imports and mitigate the economic downturn caused by high energy prices since the Russian war of aggression on Ukraine starting in February 2022.[90] To contribute to finance the REPowerEU amendment of the Recovery and Resilience Facility (RRF),) the EU decided in Regulation (EU) 2023/435 to frontload the sale of EUAs from 2027-30 to 2023-26, thereby increasing auction levels in the EU ETS in the short-term. This was implemented in the secondary legislation amending the EU ETS Auctioning Regulation 1031/2010 adopted on 17 October 2023 which financed REPowerEU mainly frontloading allowances from the Innovation Fund and Members States' auctioning volumes, with only a very small amount taken from the MSR to partly replenish the Innovation Fund.[91] For 2023, the additional auction volume was 38.4 million EUA. While this is a relatively low share of the total supply of allowances of 1,064 million, the confusion between the initial proposal and the adopted legislation and the signalling effect around the potential market intervention led to a significant price drop. In other words, the price drop was not caused by the actual intervention leading to a change of fundamental price drivers but rather the perceived increase in regulatory uncertainty. Several position papers submitted as part of the open public consultation expressed that they see using the MSR as financing tool as undermining the EU ETS's effectiveness and credibility, potentially distorting price signals. This perception stems from the initial proposal instead of the actual adopted legislation.

The three instances of unanticipated price drops in the context of the pandemic and the energy price crisis in February and November 2022 as well as in November 2023 happened at short notice. The frequency of MSR intervention is too low to immediately react. The MSR is constructed in a way that it reduces supply starting from September for a demand-supply imbalance in the previous year, i.e., if a demand shock occurs in January, the MSR starts reacting 21 months later. However, market participants can anticipate that the rule-based MSR will react at that time through an automatic mechanism that does not depend on a further decision by the regulator. As such, the MSR contributes to stabilising the market in the event of a shock even when its actual intake of the ensuing surplus is not immediate.

Note that while the years since the start of operations of the MSR in 2019 have experienced several economic and political turbulences, both the 2022 and the 2024 ESMA Market Report on EU carbon markets[92] did not identify any relevant problems regarding the functioning of the EU ETS, with historical and intraday volatility at low levels and even declining from 2022 to 2023. The 2022 ESMA report points out the EUA markets resemble markets for energy commodities in terms of volatility, which by nature also reacted to the economic and political developments described above.

4.1.2.1.3.3 MSR and market confidence

The discussion of price drops in the previous subsections shows that EUA prices are also driven by factors beyond market fundamentals. There are a number of intangible factors that we bundle, analyse and evaluate here under the umbrella of market confidence.

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89 For instance, Homaio: https://www.homaio.com/post/why-did-eua-prices-fall-so-much-at-the-end-of-2023-and-the-begining-of-2024

90 https://ec.europa.eu/commission/presscorner/detail/en/ip_22_7717

91 https://veyt.com/articles/title-eua-sale-for-repowereu-reaches-eur2-bn/

92 Market Report on EU carbon markets – 2024, ESMA50-43599798-10379

Stephan Salant raised in an academic paper from 2016 that the EU ETS was ailed by regulatory uncertainty and potential policy interventions depressing prices.[93] Confidence in the instrument has much improved since then, which ultimately shows in increased allowance prices. Most stakeholders interviewed for this evaluation confirmed that confidence in the market increased as a result of the package of reform elements. While the individual effect of the MSR on confidence cannot be assessed, stakeholders perceive the MSR as an integral part of the reform package.

There is however a second element of how the MSR influenced confidence in the market. Stakeholders raised in the conducted interviews that the MSR is complex and not fully understood by market participants. This might lead to reduced relevance of market fundamentals compared to intangible factors when market developments become more difficult to assess. The efficiency evaluation in Section 4.1.2.2 will further assess the topic of complexity.

4.1.2.1.4 Response to evaluation questions on effectiveness

1a. Did the MSR reduce the total number of allowances in circulation as expected?

Yes, the MSR reduced the TNAC, and its high level caused by historical demand-supply imbalances as expected. It did this quicker than expected as the intake rate was higher that envisioned by the 2014 Impact assessment. Stakeholders confirm this assessment: 64% find in the OPC that the MSR has been moderately or very effective in addressing the structural surplus in the EU ETS that has been accumulating since 2009.

1b. Has the MSR mitigated the build-up of a new surplus?

The MSR could mitigate the build-up of a new surplus but could not fully absorb it. Due to a substantial build-up of new surplus in the evaluation period between 2013 and 2024, the TNAC is still at a level of 1,148 million EUA, substantially above the target value of 833 million EUA. The underlying reason for this is that verified emissions declined at a faster rate than expected and allowance supply did not decrease at the same rate.

1c. For shocks between 2019 and 2024, has the MSR contributed to mitigating price crashes?

Over the evaluation period, the EUA prices increased significantly as a result of different reforms improving the EU ETS. Stakeholders perceive the elements of the EU ETS reform as blended package. The MSR was one important element of reform among others that strengthened the EU ETS.

In the six years in which the MSR is now operating, the market saw a number of price drops. The MSR mechanism is constructed in a way that it reacts only delayed to shocks and other events. Hence no direct link between price drops and the effect of the MSR can be established. However, as the MSR strengthened confidence in the EU ETS, it had an overall strengthening effect on allowance prices.

1d. Has the MSR increased confidence into the EU ETS as main driver for long-term decarbonisation in the EU?

While the individual effect of the MSR on confidence cannot be assessed, stakeholders perceive the MSR as an integral part of the reform package that led to a strengthening of the market.

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[93] Salant, 2016. "What ails the European Union's emissions trading system?" *Journal of Environmental Economics and Management*, Vol. 80, November 2016, p. 6-19.

The MSR potentially increased the complexity of market fundamentals (discussed in Section 4.6). There is a risk that this reduced the relevance of market fundamentals in the behaviour of market participants.

4.1.2.2 Efficiency

The evaluation of efficiency complements the analysis of whether a measure achieved its objectives by comparing its costs and benefits and their distribution among different stakeholders. The ex-post evaluation assesses if costs and benefits occurred as expected, highlighting unanticipated developments and drawing conclusions on how small adjustments of the measure can reduce its costs or raise its benefits with a particular focus on potential simplification and burden reduction. Note that while the previous section analysed the effectiveness of the invalidation mechanism separately from the effectiveness of the general MSR to disentangle effects, the efficiency evaluation analyses the costs and benefits of the MSR as a single tool. Ideally, the efficiency evaluation would aim to quantify costs and benefits. In the case of the MSR, this is a difficult endeavour due to the nature of the MSR and how it works. The MSR has a direct, quantifiable effect only on allowance supply. How it affects allowance prices and how these prices translate into different implied costs and benefits for market participants is much more difficult to quantify. Like this evaluation, the 2014 Impact Assessment and the 2021 MSR Review have only been able to quantify the MSR efficiency to a very limited extent.

As explained in detail in Section 2.2.2 since its adoption in 2015 the MSR underwent substantial reforms adjusting its configuration (e.g. by a higher intake rate) and introducing the invalidation mechanism. These changes were not foreseen by the initial IA conducted in 2014. Hence, analogously to the evaluation of effectiveness, the efficiency evaluation can only use the 2014 IA as point of comparison for the period of 2013 to 2017, relying on other sources for the period 2018 to 2024. The information of MSR efficiency provided in the 2014 IA is limited even for the evaluation between 2013 and 2017.

4.1.2.2.1 Anticipated costs

Direct costs for the implementation of the MSR have been low. The main task is to prepare the annual TNAC Communication. The Commission estimates the effort for this process to be around 15 working days, including the calculation of TNAC figures by DG CLIMA, the legal review and supporting IT services. Similarly, the additional direct effort for Member States is negligible. However, as an interviewee from the public sector pointed out, there is some cost related to the uncertainty around annual auction levels and hence revenues. As discussed in the effectiveness evaluation, the MSR has likely had some effect on EUA prices, especially around the 2018 reform. There is, however, a high level of uncertainty on the exact impact on prices. The 2014 IA anticipated a cost-shifting effect from future to present of the MSR with higher EUA prices in the short run over the MSR intake period and lower prices when these allowances are reinjected into the market. This is confirmed by other modelling efforts, e.g. in Bocklet et al. (2019). As discussed above, while the fundamental effect of the MSR on prices induced by cost-shifting and the invalidation of allowances is generally considered low, a substantial price effect was likely induced by the reform packages (in 2018 and for Fit for 55) including the MSR boosting confidence into the EU ETS.

Higher prices will increase costs for compliance entities under the EU ETS, potentially increasing costs for consumers of manufactured goods, electricity and heat, creating incentives for decarbonisation in the sectors covered by the ETS. However, in aggregate, these additional costs are balanced out as they generate auction revenues that can and have been redistributed.

This happened through Member States as well as through EU ETS-related programmes at EU level like the Innovation Fund, the Modernisation Fund and indirect cost compensation programmes at Member State level. As pointed out by the 2021 MSR Review (p. 44f.), higher prices mainly affect emission-intensive trade-exposed sectors. Within these sectors, firms that can abate emissions at lower costs might even benefit from price increases as they can strengthen their competitiveness. Similarly, firms that were able to bank unused allowances allocated for free to them, benefited from higher prices.

One ambiguous aspect regarding the MSR evaluation is whether it improved the efficiency of how allowance supply in the EU ETS is distributed throughout the years. Leaving the invalidation mechanism aside, the MSR shifts allowance supply from the present to the future. From the viewpoint of economic theory, this decreases the efficiency of the EU ETS as it limits the flexibility of firms to bank allowances now and to shift their abatement across time, determining the abatement path that minimises their costs. Bocklet et al. (2019) estimate that the MSR in its post-2018 reform configuration could add between 1-2% to the present value of total costs if the LRF of 2.2% was continued until allowance supply drops to zero.

The modelling exercise is, however, based on the strong assumption that regulated entities have perfect foresight and are rationally optimising their abatement behaviour over decades.[94] The 2014 IA, in turn, points out that experts considered the efficiency of the EU ETS to be low in the consultation year. Several experts stated that the carbon price signal at the beginning of Phase III was watered down, leading to inefficiently high prices in the long run. If the price dilution was caused by a limited foresight of market participants and a lack of confidence into the EU ETS, the MSR improved efficiency. Beyond this qualitative argument on the dilution of the price signal, the analysis of the 2014 IA is of limited value for the MSR efficiency evaluation in the current evaluation. This is because the 2014 IA measured efficiency as decrease in surplus and not as function of overall abatement costs.

The ambiguity of the effect of the MSR on intertemporal efficiency has already been discussed by the 2021 MSR Review (p. 51). The authors point out that TNAC increases can stem from an excess, therefore inefficient, surplus in the market but similarly from more complex market dynamics related to anticipatory banking reflecting an expectation of future scarcity in the market or of the effect of complementary policies. If TNAC increases come from the latter two, the MSR potentially decreases the efficiency of the EU ETS, as pointed out above.

4.1.2.2.2 Unanticipated costs

One category of interviewed stakeholders, academics, indicated that the MSR has induced unanticipated challenges by introducing uncertainty around annual auction volumes, increasing the complexity of EU ETS price formation and reducing the overall transparency of the EU ETS. This uncertainty would likely cause some additional costs for regulated entities, authorities and other stakeholders like academics, but such indirect costs are difficult to pinpoint and quantify. While the 2014 Impact Assessment lists the lack of simplicity as one of the weaknesses of the proposed MSR (p. 56f.), the complexity of the mechanism was not analysed and likely not fully understood when designing the instrument. The number of academic publications analysing the effect of the MSR are witness to this. Furthermore, the implemented MSR with the reforms of the intake rate and the introduction of the invalidation

[94] This assumption has been subsequently challenged, for instance in Quémin & Trotignon (2021).

mechanism is slightly more complex than the options from the 2014 IA. Various stakeholders identified several features of the MSR that are complex, among others:

- TNAC is a new concept describing the private holdings of allowances. The TNAC increases when allowance supply exceeds verified emissions in a given year. Allowance supply, however, directly depends on the MSR.
- The level of the intake rate appears arbitrary and its effect on intake difficult to qualify. The intake rate started at 12% and is now at 24% of TNAC. It is not intuitive if 12% leads to a high or low intake level and if 24% are substantially different.
- MSR release will likely happen in the 2030s. The exact release period, however, depends on technological developments and complementary policies driving verified emissions. There is a high degree of uncertainty around the timing of release and hence future allowance supply.
- The initial invalidation mechanism with the dynamic threshold of the previous year's auction volume made invalidation volumes opaque. This has been corrected by the Fit for 55 reform setting a fixed threshold of 400 million EUA, increasing predictability of invalidation volumes.
- The overall level of invalidations and hence the overall number of allowances in the system depend on several factors and are hard to predict, creating uncertainty around allowance supply.

It is overall manageable to understand these features. However, in aggregate, the functioning of the EU ETS becomes more complex. As one of the academic MSR experts interviewed for the evaluation pointed out: *"The big drawback of the MSR is that it created a regulatory regime that the affected people do not understand."* Those taking the time to understand the MSR face unanticipated high one-off costs. As another interviewee from the public sector put it: *"I must admit that analysing the MSR mechanism, both in the context of the concept, legislation, implementation process and then effects, took a lot of time, energy and reflection within our team."*

Regulated entities are dealing differently with this increased complexity. Bigger companies have their own departments dealing with trading allowances. These companies had to adjust their EU ETS models to include the newly introduced MSR rules, likely hiring new or training existing staff. Smaller entities usually do not trade allowances themselves but rely on intermediaries. They will likely face a higher service fee in consequence of the MSR introduction.

4.1.2.2.3 Anticipated and unanticipated (co-)benefits

The main anticipated benefits of the MSR can be derived from its objectives. The reduction of the historical and new excess allowance surplus is the most direct benefit. While more difficult to quantify, support for the stabilisation of prices in times of low-price levels as well as of the signal the MSR provided in terms of confidence into the EU ETS and credibility of the commitment of the EU to this instrument are important benefits. These benefits are discussed in more detail in the evaluation of the MSR effectiveness in Section 4.1.2.1.1

This section focuses on whether the MSR has led to any benefits beyond those intended by the MSR objectives.

By construction, the MSR is meant to have limited effects outside the EU ETS context, and hence potential co-benefits. Neither the 2014 Impact Assessment nor the 2021 MSR Review mention specific co-benefits.

To the degree that the MSR contributed to price increases in the EU ETS, this generated additional revenues for EU Member States which invested them to a large share into climate-related programmes. Furthermore, the higher price led to increased decarbonisation efforts, fostering the development of low-carbon technologies and generating a positive environmental impact. The invalidation mechanism de facto lowered the number of allowances and therefore emissions.

A hard-to-quantify unanticipated co-benefit of the MSR is that it increased interest in and availability of data on the EU ETS. The annual TNAC Communications that are released in May help market participants and other stakeholders assessing the market situation, especially the development of verified emissions and allowance supply over time. Similarly, the adoption of the MSR inspired an array of research and active discussions on EU ETS market dynamics in general.

4.1.2.2.4 Lessons learned and recommendations

A lesson learned on efficiency, that the Commission already applied in the Fit for 55 reforms, is that mechanisms like the MSR should be implemented with least complexity, decreasing the cost for regulated entities, authorities and other stakeholders that comes with understanding how the MSR changes the functioning of the EU ETS and the EUA price formation. A number of the position papers that were received as part of the open public consultation, call for an increase in transparency of MSR related data and predictability of the MSR movements, indicating that there might be still room for improvement, for instance finetuning MSR parameters. Note that there is a trade-off between a mechanism that is rule-based and a mechanism that can flexibly react to changes in market conditions.

Overall, the MSR had mostly indirect costs and benefits for regulated entities under the EU ETS. This is highlighted by the results of the open public consultation on this matter: While 39% responded that the MSR is moderately or very efficient, another 35% did not know how to answer. One potential reason for the significant number of "Do not know" answers could be that these respondents are not aware of the costs and benefits of the MSR. This, in turn, reflects on the unanticipated complexity of the mechanism.

One way to leverage the benefits of the MSR is to improve the presentation of data from the TNAC Communications. For example, a small straightforward improvement would be to publish the Excel tables providing data from all years of TNAC Communications. This would ease the accessibility of TNAC data and support regulated entities, market participants as well as researchers in working with MSR data.

4.1.2.3 Coherence

The evaluation of coherence assesses how well the MSR is functioning in a harmonised way with other elements of the EU ETS (internal coherence), other EU climate and energy policies as well as policies at Member State level (external coherence). Neither the 2014 Impact Assessment nor the 2021 MSR Review, or other studies have identified obstacles to the internal coherence of the MSR.[95] This is also confirmed by the open public consultation. Question 3a

[95] Pahle et al. (2023) are pointing out a future issue of internal coherence, not relevant for a backward-looking evaluation. They find that the invalidation mechanism can cause a price spiral if the EU ETS cap becomes tighter in the light of the EU's 2050 net-zero target. If market participants expect a tighter market in the future, they will increase abatement efforts now, banking allowances in response to an expected future scarcity. If this additional banking leads to TNAC levels that trigger MSR intake and invalidation of allowances, this will further increase the scarcity of allowances in the EU ETS, potentially inducing further banking.

of the evaluation matrix, *Is the MSR aligned to other elements of the EU ETS?* can therefore be affirmed and the evaluation focus will be on external coherence.

Coherence is mainly evaluated for the overall EU ETS (in Section 4.1.2.3) but there are some aspects that are particularly relevant for the evaluation of the MSR as individual feature of the EU ETS.

4.1.2.3.1 MSR and complementary policies

The 2014 Impact Assessment discusses the coherence of the MSR with complementary policies. Complementary policies are defined as a subtype of overlapping policies whose primary or secondary objectives are aligned with the assessed policy. In the context of the EU ETS, overlapping policies are all other climate or energy policies that directly or indirectly aim to reduce emissions (the 2014 IA mentions renewable energy, energy efficiency policies and policies to reduce the use of carbon-intensive fuels). As with the discussion of efficiency, the 2014 IA focusses on the static reduction of the allowance surplus. It hence falls short of identifying and analysing the intricacies of how the MSR interacts with complementary policies. Since the initial IA, there has been a large body of academic literature analysing the interaction between the EU ETS, the MSR and complementary policies. This has been reviewed and extensively discussed in the final report for Task 1 of the DG CLIMA project on *Issues and Options for EU Emissions Trading after 2030*, published in 2024.[96]

On the one hand, the invalidation mechanism of the MSR increases the coherence between EU ETS and complementary policies. Without it, any complementary climate or energy policy covering EU ETS sectors reduces demand for allowances, thereby reducing EUA prices and de-incentivising decarbonisation which leads to higher emissions and demand for allowances. From a theoretical point of view, the net effect of complementary policies on emissions is zero. This is the so-called waterbed effect. The MSR in its original design could not have fixed the waterbed effect as it only adds a shift of allowances and hence abatement efforts over time. With the adoption of the invalidation mechanism in 2018, however, it permanently removes allowances, thereby mitigating or even overcoming the waterbed effect.

On the other hand, the literature review discusses dynamic effects of how the MSR and the invalidation mechanism work (p.23f.). While several research papers find that the MSR works as expected in the context of unanticipated shocks caused, for instance, by economic crises, the MSR has unintended effects in reaction to anticipated shocks which are often related to complementary policies like coal-phase outs or renewable energy support. If the market expects that in the future complementary policies will reduce emissions and hence the carbon price, abatement efforts today will also decrease. This in turn leads to a lower TNAC and less MSR intake and invalidation. In the worst case, this effect can overcompensate the initial emissions reduction induced by the complementary policy, leading to overall higher emissions. This effect can occur in interaction with EU or Member State-level climate or energy policies.

A recent paper by Perino et al. (2025)[97] maps overlapping climate policies regarding additional emission reduction effects, assuming the MSR threshold of 833 million EUA is reached in

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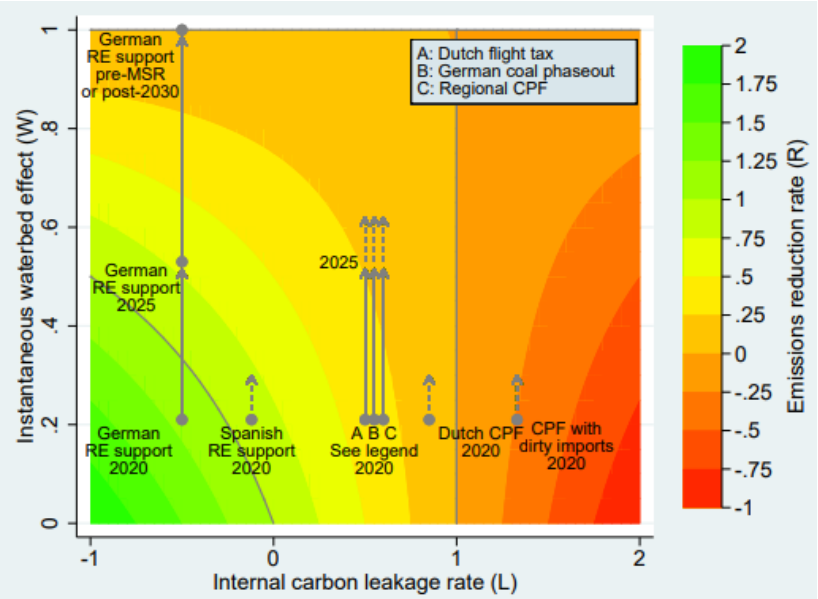
[96] DG CLIMA, 2024: "Issues and Options for EU Emissions Trading after 2030. Final Task 1 Report – Integrated reporting on literature review", interviews with experts/stakeholders and stakeholder survey, online: https://op.europa.eu/en/publication-detail/-/publication/67267406-313b-11f0-8a44-01aa75ed71a1/language-en

[97] Perino, Ritz and van Benthem, 2025. "Overlapping Climate Policies", Economic Journal, https://doi.org/10.1093/ej/ueaf021

2030. In Figure 18, the x-axis is the internal carbon leakage rate, i.e. the shift of emissions from one jurisdiction to another, including carbon-intensive imports, at a fixed EUA price. Internal carbon leakage is measured between -1 and 2. At a rate of 1, all emissions reduced by the complementary policy are 1:1 replaced by new emissions somewhere else. Above 1, total emissions increase, e.g. through carbon-intensive imports. Below 0, the complementary policy incentivises emission reduction elsewhere as with the German renewable energy (RE) support that decreases investment costs for RE. The y-axis is the waterbed effect, i.e. the overall effect on emissions covered by the EU ETS with an endogenous EUA price. For instance, the German RE support pre-MSR had a waterbed effect of one. All emission reduction achieved led to lower EUA prices and higher emissions elsewhere under the EU ETS. The German coal phase-out or a regional carbon price floor (CPF), in turn, had in 2020 a low waterbed effect of 0.2 as allowances were invalidated through the MSR. The main finding of the paper is that the waterbed effect crucially depends on the timing of overlapping policies, as illustrated for the German renewable support pre-MSR, 2020, 2025 and post-2030. It is worth mentioning that Germany's voluntary cancellation related to its coal phase out considers of the MSR's intakes and only cancels what the MSR does not. Germany and the Commission communicate transparently and timely on this.

Figure 18: Map of effects of complementary policies in the EU ETS



Source: Perino et al. (2025)

4.1.2.3.2 Alignment to other EU climate or energy policies and lessons learned

As discussed in Section 4.1.2.1,1 the MSR has been successful in strengthening the EU ETS. As the EU ETS is the cornerstone of EU climate policy, the adoption of the MSR is coherent as part of the broader climate policy mix. However, the MSR potentially enables other EU climate and energy policies to interfere with the EU ETS's environmental integrity and effectiveness. A number of interviewed stakeholders across sectors mentioned as negative example for this the use of MSR allowances for financing the REPowerEU programme. As discussed previously, although this in fact never happened and there was only a frontloading of allowance supply outside the MSR, the proposal undermined confidence into the EU ETS. From a coherence point of view, it can be added that, even if that did not happen in this case, a potential scenario arose in which the MSR as an allowance reserve could be used for adjusting auction volumes and generate additional revenue in response to political considerations not

directly related to the ETS. As an interviewed industry representative put it: *"Such interventions need to be thought through carefully because they create uncertainty."*

4.1.2.3.3 Alignment to policies at Member State level

While the paper by Perino et al. (2025) outlines how the timing of individual complementary policies at Member State level depends on its interaction with the MSR, and in particular with the invalidation of allowances, this subsection looks specifically at the interactions between the MSR and the German coal-phase out, going beyond the academic perspective, and including a consideration on administrative effort and concrete implementation challenges.

The German coal phase-out is an interesting case because it is the only Member State policy that used Article 12(4) of the ETS Directive This provision allows Member States to cancel EUAs they would have auctioned otherwise, so that the additional emission reduction effect achieved by the closure of electricity generation capacity stays intact. Member States can withdraw allowances up to the average verified emissions of closed power plants over a period of five years preceding the closure.

Beyond the invalidation of a fixed number of allowances, the German government intended to implement the coal phase-out as neutral regarding the EUA price, i.e. without any waterbed effect, as experts from the public and academic sector interviewed for the evaluation explained. This led to complicated modelling efforts as price neutrality also needed to take into account the interference of the policy with the MSR intake. As a result, Germany failed in its attempt to withdraw allowances for phased-out capacities in 2021.[98]

Another academic expert highlighted, however, that this failure was irrelevant. As long as the coal phase-out happens when the TNAC is still above 833 million, the MSR will invalidate allowances that reduced demand in response to the policy. This is the combined effect of the introduction of the upper buffer zone with one-for-one MSR intake between a TNAC of 833 and 1096 million allowances and the fixed invalidation threshold of 400 million. Article 12(4) will only become relevant once the TNAC falls under 833 million allowances.

4.1.2.3.4 Lessons learned and recommendations

The evaluation of coherence between the MSR and the EU ETS on the one hand and complementary policies on the other raises the broader question of which role complementary policies should play next to the EU ETS to support decarbonisation. The EU ETS sets a price signal, adjusting the marginal costs of low- versus high-carbon technologies or activities to account for damages from climate change and to make polluters pay for the external costs of their decisions. The absence of climate change damages from the polluters' decision making is not the only market failure hindering decarbonisation and requiring government intervention. For instance, infrastructure like smart grids and EV charging networks are public goods and would not be provided adequately without government intervention. This requires a climate policy portfolio where the EU ETS is a central but not the only policy for the low carbon transition and brings the issue of the coherence of the whole portfolio to centre stage.

Overall, the interactions of the MSR and complementary policies are more complex than initially foreseen, especially through the interaction with the invalidation mechanism adopted in 2018 which leads to changes in expectations of market participants. However, the new upper

[98] See also Carbon Pulse, 2025: "Ahead of German elections, government faces scrutiny over coal phaseout as EUA cancellations lag", 21 February 2025, https://carbon-pulse.com/371265/

buffer introduced by the Fit for 55 reform largely mitigates the problem of the waterbed effect and hence improves coherence.

As in the evaluation of the MSR efficiency, the discussion of coherence circled back to the topic of complexity and makes the assessment of the effects of complementary policies difficult. The main recommendation for future adjustments of the MSR is hence to consider possible simplifications as well as to increase transparency by providing data and guidance material. The latter helps assessing interactions with complementary policies and hence understanding coherence issues, ideally even before future complementary policies are adopted.

A majority of interviewed stakeholders across different sectors criticised the proposal for financing the REPowerEU programme from MSR allowances, even if the adopted intervention relied on allowances frontloaded from the Innovation Fund and Member States' auctioning. The MSR could potentially be strengthened by adding safeguards that prohibit any arbitrary use of the allowances stored in the MSR, to avoid any uncertainty of possible unanticipated political interventions in the future.

Lastly, although this is a forward-looking assessment based on a number of underlying assumptions, rather than a backward-looking assessment covered by this evaluation, the potential price spiral identified by Pahle et al. (2023) indicates that the MSR parameters need to be carefully adjusted to be fit for a future market that could in the long run be characterised by a potential scarcity of allowances. Among a series of potential ETS adjustments to address future scarcity, removing the invalidation mechanism could contribute to preventing such a price spiral from materialising.

Note that the points on which the coherence of the MSR can be improved are less important than addressing issues of overall EU ETS coherence. In the open public consultation, only 7% of respondents to the open question of how to improve coherence refer to the topic of market stability and MSR. Topics like external coherence, international cooperation and free allocation, competitiveness and carbon leakage received more attention from the respondents.

4.2 How did the EU intervention make a difference and to whom?

4.2.1 What is the EU-value added of the EU ETS?

The EU added value refers to the extent to which the objectives and impacts of the ETS Directive could not have been achieved by Member States acting independently. Evidence from literature confirms that coordinated, supranational implementation has delivered greater effectiveness, efficiency, and equity than would not have been possible through national action alone. Across environmental, economic, and administrative dimensions, the EU ETS demonstrated strong added value.

The fact there has been little to no analysis in the literature with regards to replacing the EU ETS with alternative national schemes indicates that the added value of implementing the ETS and the EU level is widely accepted. It is unlikely, and there is no evidence from the literature to suggest, that greater effectiveness, efficiency and equity could have been achieved through national action alone.

A central pillar of the EU ETS added value concerns the creation of a harmonised carbon market that preserves the integrity of the single market and ensures a level playing field for regulated sectors operating in different Member States. The 2018 revision further reinforces this harmonisation by establishing EU-wide benchmarks and phasing out National Allocation Plans, and by implementing uniform carbon leakage criteria across the EU. By establishing

common rules on cap setting, emissions monitoring, allowance allocation, and compliance, the ETS Directive avoids competitive distortions that would arise from uncoordinated national systems. Identical installations across different Member States receive the same treatment under fully harmonised benchmarks and allocation rules, something that national legislation alone cannot achieve[99].

Without EU level coordination, Member States would face a "prisoner dilemma" dynamic: fearing the competitive disadvantage of setting ambitious caps, they would collectively set weaker targets. Harmonised MRVA procedures and the establishment of a central EU registry have also substantially reduced the risk of carbon leakage within the EU and improved transparency and compliance across jurisdictions[100][101].

The EU ETS was also able to deliver emissions reduction at a lower cost than it would have been possible under parallel national policies. Pre-implementation modelling estimated that reaching the EU's Kyoto targets without a common EU-wide system would have been at least 20% more expensive[102]. The pooling of abatement potential across countries allows for more efficient emissions reductions where they are cheapest, and the move from 28 separate National Allocation Plans (NAPs) to a single cap-setting and auctioning system has simplified administration for regulators and firms. Centralised software development, EU-wide state aid guidelines, and streamlined verification systems have generated substantial economies of scale, strengthening the system's efficiency compared to any conceivable patchwork of national trading systems[103].

Moreover, the EU ETS, as set up during the period under evaluation, covered approximately 40% of EU emissions, including electricity generation, heavy industry, and aviation. Its cross-border reach, which extends to EFTA countries, enables the system to regulate emissions in sectors that naturally transcend national boundaries, such as energy networks and industrial supply chain[104][105].

A major area of EU added value stems from the EU ETS's ability to stimulate low-carbon innovation and investments, which would be far more limited under national systems. While the literature remains limited and incomplete there has been evidence to show that the EU ETS has increased innovation activity in low carbon technologies among regulated entities compared to a counterfactual scenario.[106]Regulated firms under the EU ETS have been shown to increase low-carbon innovation by up to 30%, with a statistically significant 15% in revenues

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99 EVALUATION OF THE EU ETS DIRECTIVE, 2015, https://climate.ec.europa.eu/system/files/2016-11/review_of_eu_ets_en.pdf

100 Antoine Dechezleprêtre, Caterina Gennaioli, Ralf Martin, Mirabelle Muûls, Thomas Stoerk, 2021. "Searching for carbon leaks in multinational companies", https://doi.org/10.1016/j.jeem.2021.102601.

101 EVALUATION OF THE EU ETS DIRECTIVE, 2015

102 Delbeke, J, Hartridge, O, Lefevere, J, Meadows, D, Runge-Metzger, A, Slingenberg, Y, Vainio, M, Vis, P, & Zapfel, P, 2006. "*EU Energy Law". Volume 4. The EU Greenhouse Gas Emissions Trading Scheme.* Netherlands.

103 EVALUATION OF THE EU ETS DIRECTIVE, 2015

104 Griet Verhaeghe, Volker Mauerhofer, 2023. "National progress towards supranational climate & energy goals due to policies & their mixes? Insights from Northern & Western Europe", https://doi.org/10.1016/j.jenvman.2023.119304.

105 Antoine Dechezleprêtre, Caterina Gennaioli, Ralf Martin, Mirabelle Muûls, Thomas Stoerk (2021)

106 Raphael Calel & Antoine Dechezleprêtre, (2016). "Environmental Policy and Directed Technological Change: Evidence from the European Carbon Market," The Review of Economics and Statistics, MIT Press, https://ideas.repec.org/a/tpr/restat/v98y2016i1p173-191.html

and 8% increase in fixed assets over the 2005-2012 period[107]. These outcomes are not only driven by the carbon price signal, but also by the financial architecture enabled at the EU level. The 2018 revision of the EU ETS has established dedicated funding mechanisms that pool ETS auction revenues from Member States into central funds, namely the Innovation Fund and the Modernisation Fund[108]. These funds are then redistributed based on need and ambition, supporting capital intensive decarbonisation projects that single Member States would not be able to finance alone. Programmes such as NER300 and the Innovation Fund enable the scaling of technologies like green hydrogen, CCS, and industrial electrification.

Feedback from the stakeholder consultation broadly confirms the findings. 45% of respondents[109] emphasised the EU's added value in harmonising implementation across Member States, avoiding a fragmented patchwork of national schemes and ensuring a common price signal.

4.2.1.1 To what extent could the changes brought by the Directive have been achieved by national or individual Member States' measures only?

Across all dimensions, the evidence suggests that the Member States acting independently would face significant barriers to replicate the outcomes of the EU ETS. National systems would likely experience:

- Inconsistent carbon pricing and ambition levels[110]
- Increased administrative and monitoring burdens[111]
- Fragmented investment signals and diminished innovation incentives[112][113]
- Higher risks of carbon leakage and intra-EU competitiveness distortion[114][115]

The ETS's harmonised framework mitigates these challenges, thanks to collective cap setting, regulatory consistency and shared financial tools.

4.2.1.2 What would be the most likely consequences of stopping or downscaling the existing ETS Directive?

A further point to consider when evaluating the EU added value of the ETS Directive is what would be the consequence of downscaling or discontinuing the EU ETS. Stopping or significantly downscaling the EU ETS would likely reverse many of the environmental and economic benefits achieved to date. Empirical evidence shows that the ETS has contributed to speed up emissions reductions more than the EU had envisaged: 2.1% on average every year,

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107 Ibid

108 ECB 2023."Benefits and costs of the ETS in the EU, a lesson learned for the CBAM design", ECB Working Paper Series No 2764 / January

109 Question: "Please provide an explanation to support your view, in particular explaining which particular elements of the ETS you would signal out in terms of adding value or not adding value (n=220)"

110 Griet Verhaeghe, Volker Mauerhofer, 2023. "National progress towards supranational climate & energy goals due to policies & their mixes? Insights from Northern & Western", https://doi.org/10.1016/j.jenvman.2023.119304.

111 EVALUATION OF THE EU ETS DIRECTIVE, 2015

112 Antoine Dechezleprêtre, Caterina Gennaioli, Ralf Martin, Mirabelle Muûls, Thomas Stoerk (2021)

113 EVALUATION OF THE EU ETS DIRECTIVE, 2015

114 Antoine Dechezleprêtre, Caterina Gennaioli, Ralf Martin, Mirabelle Muûls, Thomas Stoerk (2021)

115 EVALUATION OF THE EU ETS DIRECTIVE, 2015

compared to 1.6% targeted in the period 2005-2016. The pace accelerated further to 2.5% in the third stage after 2013, following the ETS reform.[116]

According to the EEA (2024a), while external costs from energy-intensive industries, the majority of which are linked to impacts on human health, fell by 23% from 2012 to 2021, they still amounted to over EUR 73 billion in 2021. Across all the energy-intensive sectors, carbon dioxide (CO_2) was responsible for 58% of these external costs.

The EU ETS and the resulting carbon price has contributed to internalising the external cost of climate change for those activities that fall within the scope of the system. While there are different methods of estimating the external costs of climate change, on study on the external costs of transport[117], based on an analysis of the relevant literature, estimated a central value for short- and medium- run climate change costs of EUR_{2016} 100 t/CO_2 (or approximately EUR_{2023} 120 t/CO_2). Based on the evaluation of the carbon price, in particular since 2021 (see Figure 17), it can be said that the EU ETS resulted in internalising a significant (at least half to two thirds, depending on the price level) share of the external cost associated with the effects of climate change, especially for the power sector (see Figure 5) which did not benefit from free allocation and could pass through the resulting carbon costs. Therefore, a discontinuation of the ETS would have had a considerable impact in terms of increased external costs associated with these sectors.[118]

Moreover, discontinuation would weaken low carbon investments signals, and it would reduce ETS revenues that are used for innovation and investment to modernise the energy systems in Europe through the Innovation and Modernisation Funds, both necessary for reducing electricity prices, as well as investments by Member States to support the green and socially fair transition. Employment in affected firms[119] would go down and climate-related jobs in sectors such as clean tech, verification, consulting, and innovation support[120]. In addition, the intervention would also damage the Union's credibility as a stable economic environment, potentially discouraging future investments in consideration of the unreliable regulatory framework.

From an economic standpoint, halting the EU ETS would have led to what can seem like a double-faced outcome. On one hand, it can be estimated that a discontinuation of the ETS in 2023 would have led to a loss of approximately EUR 93 billion [121] in allowance value held by companies and the financial sector for compliance and for their investment strategy as allowances are traded financial instruments. On the other hand, companies would not have been subject to compliance worth approximately EUR 44 billion that were paid in auctions in 2023[122]. If able to do so, companies may have passed on these compliance costs to the consumers.

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116 ECB (2023)

117 European Commission: Directorate-General for Mobility and Transport and CE Delft, 2020. "Handbook on the external costs of transport – Version 2019 – 1.1", Publications Office

118 European Environment Agency (EEA), 2026. "Zero-pollution, decarbonisation, and circular economy in energy-intensive industries", online: https://www.eea.europa.eu/en/analysis/publications/zero-pollution-decarbonisation-and-circular-economy-in-energy-intensive-industries

119 Antoine Dechezleprêtre, Caterina Gennaioli, Ralf Martin, Mirabelle Muûls, Thomas Stoerk (2021)

120 EVALUATION OF THE EU ETS DIRECTIVE, 2015

121 The value was estimated considering the TNAC in 2023 according to C/2021/3415 and the average EUA price in 2023 (7a7780d7-8f18-42e0-aff9-5ade23e63d7e_en)

122 Based on primary market auction report from EEX for 2023.

However, the consequence on elimination the compliance costs must be carefully considered. Most allowances are purchased by the energy sector, which passes on the price to consumers. If the price is not passed on any longer, removing the cost of compliance should in the short run lead to lower energy bills, rather than increasing companies' budgets. In the long run, the reduction in energy costs would be outweighed by the increase in cost from an increase in fossil fuel dependency, while Renewable Energy Sources (RES) generally offer lower wholesale electricity prices. Removing the compliance obligation removes the carbon price incentive for RES: (i) it benefits non-marginal producers, especially those with no emissions, such as RES and improves their business case and development and (ii) incentivises fuel switching, in particular from coal to gas. Together, these two factors have been major abatement channels in the ETS and are the cause of most of the system's 50% emission reductions achieved thus far. Thus, in reality, the impact will be negative overall from both perspectives.

At an international level, dismantling the EU ETS would undermine the EU's credibility in international climate diplomacy and weaken the EU's position on shaping global carbon pricing mechanisms and border adjustment instruments[123].

The strongest argument against stopping or downscaling the EU ETS remains in the long-term costs of inaction, which would dwarf any short-term gain induced by reduced compliance costs. The cost of climate change has both a social and economic dimension. From a social perspective, inaction increases risks related to health, extreme climate events, degradation of soil, and pollution of air. The economic and industrial cost is represented by the risk of remaining locked in high-carbon technologies, which are strongly reliant on imports of fossil fuel. Such reliance, especially in an increasingly complex geopolitical scene, undermines domestic competitiveness and will increases uncertainty.

4.3 Is the intervention still relevant?

4.3.1 Relevance of the EU ETS and how well its objectives (still) correspond to the EU climate policy objectives?

The EU ETS covers approximately 40% of total EU-27 emissions[124] from "around 10,000 installations in the energy sector and manufacturing industry as well as aircraft operators flying within the EU and departing to Switzerland and the United Kingdom".[125]

The objectives that were previously set in the 2015 proposal[126] by the Commission included the revision of the ETS Directive to ensure that emissions in scope are reduced by 43% below 2005 levels by 2030 so that it contributed to the EU's overall GHG reduction target for 2030 in the 'most cost-effective manner'. By 2024, EU ETS emissions have already reduced by approximately 50% compared to 2005 levels. However, since emissions from industry remained stable, it can be argued that the ETS is still relevant in supporting with the delivery of the EU climate policy objectives, as further emissions reductions in ETS covered sectors are needed to achieve the 2050 climate target.

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123 ECB (2023)

124 Based upon a calculation of total EU-27 emissions in 2023 from the EEA greenhouse gases — data viewer | Maps and charts | European Environment Agency (EEA) compared to EU-ETS emissions for the same year from the EU Emissions Trading System (ETS) data viewer | Maps and charts | European Environment Agency (EEA).

125 Refer to Scope of the EU ETS - Climate Action - European Commission, https://climate.ec.europa.eu/eu-action/carbon-markets/eu-emissions-trading-system-eu-ets/scope-eu-ets_en

126 COM(2015) 337 final

The CO_2 price signal from the setting of a cap-and-trade scheme under the EU ETS allowed for the identification and realisation of abatement across the EU Member States where it was more economically efficient to do so. The targets were therefore originally set so that the contribution of ETS sectors to the overall GHG reduction target was higher than for non-ETS sectors. The exact share was informed by macroeconomic modelling to determine the most efficient split between ETS and non-ETS sectors to achieve the overall target for 2030. The ETS target has subsequently been updated to a 62% reduction below 2005 levels by 2030 to align with the enhanced ambition of the EU economy-wide climate target for 2030 of reaching a 55% reduction below 1990 levels in GHG emissions by 2030.[127]

The prevention of carbon leakage and the encouragement of innovation were also set as further objectives (see Section 8.3.3.2) and these are both very much aligned with the EU climate policy objectives as the EU aims to support a competitive industry as it decarbonises, by providing financial support and using the price signal of the EU ETS to drive innovation. As long as certain industrial sectors remain high emitters of CO_2 and assuming that comparable levels of carbon pricing do not exist in key trading partners, then carbon leakage will remain a valid concern in the context of the EU ETS. The achievement of these objectives is assessed in detail in Section 8.3 of this evaluation on the topic of carbon leakage.

4.3.1.1 Is EU ETS (a cap-and-trade system) still relevant as an effective and efficient instrument for achieving the EU climate policy goals and priorities?

The 2015 evaluation of the EU ETS concluded that a cap-and-trade system was an effective and cost-efficient instrument for achieving emissions reduction, since it targets directly major emitters and ensures that overall emissions stay within the cap. More recent literature reinforces this view, clarifying the comparison with a carbon tax. Chen & al (2020)[128] show that, although both carbon pricing instruments stimulate clean innovation, cap-and-trade generally induces larger investment in low-carbon technologies and achieves larger emissions reductions, provided that the carbon price resulting from the cap-and-trade system are set appropriately. At the same time, Stavins (2022)[129] emphasises that a carbon tax and a cap-and-trade system differ in terms of price volatility, revenue certainty, and administrative complexity. These findings, which are aligned with the conclusions provided by the 2015 evaluation, suggest that the EU ETS remains relevant as a cap-and-trade system, especially giving its proven capacity to deliver emissions reduction and stimulate innovation (see Section 4.1.1.2 on Efficiency), while ongoing design adjustments, such as the Market Stability Reserve are needed to address the practical limitations of a cap-and-trade system compared with a carbon tax.

4.3.1.2 How well adapted is the Directive to subsequent technological or scientific advances, or any other unexpected external influences such as the recent economic crisis?

The ETS is inherently flexible by design, since it does not mandate how operators must reduce emissions but instead ensures operators can adopt the most efficient technologies and processes available. This ensures that the system remains relevant when facing technological improvement, with increasing allowances prices continuing to incentivise the uptake of increasingly ambitious abatement options. Moreover, the reforms introduced in the 2018

[127] 'Fit for 55': Council adopts key pieces of legislation delivering on 2030 climate targets - Consilium

[128] Chen et al, 2020. "A clean innovation comparison between carbon tax and cap-and-trade system", Energy Strategy Reviews, https://www.sciencedirect.com/science/article/pii/S2211467X20300365

[129] Stavins, Robert N. (2022)

Review of the Directive have strengthened further this adaptability. The update of product benchmarks has allowed free allocation rules to better reflect technological progress and to align more closely with actual production levels (see Section 8.3 on carbon leakage), while the MSR enhances resilience by addressing allowance surpluses arising from economic crises or sudden technological shifts (see Section 4.1.2 on MSR).

4.3.1.3 Can the Directive be easily adjusted to new needs, in particular a new GHG target for the EU?

As stated in the 2015 evaluation, the EU ETS is relevant as an instrument that can be easily adjusted to new needs, and more specifically to a new GHG target. In principle, only Article 9 needs to be amended in order to adjust the Linear Reduction Function to respond to changes in GHG reduction ambition. At the same time, market interventions need to be kept to a minimum to ensure a predictable market functioning and a reliable long term price signal to build investment decisions on.

Feedback from the OPC[130] confirms that the stakeholders see the EU ETS as continuing to address needs that clearly warrant EU level action. Almost half of respondents, both from companies/businesses and NGOs, judged the Directive's objectives to remain relevant to a very large extent, and a further quarter considered them relevant to a large extent. Only a small minority of respondents viewed the instrument as only slightly or not at all relevant, and a few were undecided. These results suggest broad consensus that the ETS remains an appropriate and necessary EU-level tool for achieving climate policy goals in covered sectors.

5 WHAT ARE THE CONCLUSIONS AND LESSONS LEARNED?

5.1 EU ETS

In conclusion, the EU ETS is very much aligned to the broader climate policies of the EU with ETS sectors making a greater contribution to the achievement of EU 2030 GHG reduction target as it was more economically *efficient* for it to do so than for non-ETS sectors. There was evidence to suggest that the EU ETS has been *effective* in driving the overall emission reduction trend observed in the EU.

During the evaluation period, total emissions from stationary installations declined significantly, consistent with and exceeding the trajectory required to meet the 43% reduction below 2005 levels by 2030 set by the 2018 revision of the Directive. The strengthened CO_2 price signal under Phase IV has likely incentivised higher levels of overall abatement as reforms were undertaken to address the structural imbalance in the demand and supply of allowances that previously undermined the performance of the EU ETS in Phase III. The uptake of abatement options is likely to have been higher in the power sector than for industrial sectors and this is, in part, due to the further complementary measures that have been in place to support with the decarbonisation of electricity generation across the EU, as well the absence of free allocation that minimised the impact of the carbon price for the industrial emitters.

The *external coherence* of the EU ETS with the wider policy framework has been considerably improved following the introduction of the MSR addressing the long-criticised waterbed effect by allowing allowance supply to respond to changes in demand, including those induced by overlapping policies like RED and EED. Reforms to the EU ETS, such as reforms to free

[130] Question: "To what extent do the needs/problems addressed by the EU ETS Directive (cost-effective emissions reductions in the covered sectors to support the EU climate targets) continue to require action at EU level? (n=295)"

allocation, in recent years have started to address previous issues identified with regards to the *internal coherence* of different design elements. For example, the setting of more ambitious benchmarks for the provision of free allocation helps to enhance the impact of the CO_2 price signal to provide greater incentives for decarbonisation whilst striking a balance in protecting industry from the risk of carbon leakage. Evidence from the literature supported the argument that the implementation of the revised ETS Directive in 2018 has provided considerable EU added value to Member States and it has likely resulted in more cost-effective mitigation than would have been provided than if action only occurred at the national level.

As regards the prevention of carbon leakage, earlier studies found little evidence of carbon leakage, largely because the EU ETS in its early stages was designed to minimise such risks. However, the carbon price increases, and free allocation has been reduced, more recent analyses find small but increasingly significant evidence of carbon leakage. At the same time, the high level of protection from carbon leakage and levels of free allocation in the first phases of the ETS resulted in windfall profits and reduced incentives to invest in decarbonisation.

The revision of free allocation rules for Phase IV balanced the need for carbon leakage protection and the need to encourage the reduction in emissions. This was done by developing a more targeted carbon leakage list, more ambitious benchmarks, and the introduction of adjustments to allocation to better consider changes in activity levels. As a result, the overall volume of free allowances that has been provided to industry has declined in Phase IV compared to Phase III, but it continues to cover a significant share of the industrial emissions.

The MRVA system delivers high harmonisation and accuracy with standard methods used almost universally. The MRVA system ensures that nearly all emissions from Annex I activities are monitored and reported, with only marginal delays or omissions. The verification system ensures stringency and independence through robust accreditation, annual oversight, and consistently high compliance, though emerging capacity pressures because of the expansion of ETS activities pose risks to the quality of verification. There is a high level of confidence in the system's integrity and robustness, although the efficiency of the system could be improved. In line with the REFIT programme, a number of options for simplification and reduction costs for the MRVA programme have been identified (see Section 8.4.4.2), in particular in terms of increased use of harmonised and simplified reporting, use of default values, increased use of common IT tools by Member States.

The EU ETS auction system operated in an open manner, providing transparency and predictability for participants. Over 3000 auctions were conducted with minimal cancellations, illustrating its reliability, which resulted in raising over EUR 169 billion in auction revenue during the period of the evaluation (and over EUR 250 billion in total to date). The system's regulatory framework, bolstered by MiFID II and MAR, prevents market manipulation and abuses, maintaining the integrity of the EU ETS. Overall, the auctioning system has successfully achieved its objectives and ensured a balanced distribution among different market participants.

The Union Registry has provided a reliable and secure IT system for tracking the creation, allocation, surrender and reversal of allowances, with only minor technical interruptions due to scheduled upgrades. The Registry effectively provides accurate, up-to-date, and publicly accessible information crucial for ETS reporting. Although historical security measures have been effective, evolving risks, particularly cyber-attacks, and issues like inadequate financial and human resources, necessitate to strengthen the security of the infrastructure and to revise the operating model. Studies and security plans have identified vulnerabilities, recommending

additional security measures to adapt to the growing IT risks and market changes and recommendations have been made to enhance security measures and reconsider its business model to better align with financial market frameworks to ensure the integrity of European carbon market. Overall, the Registry system has insufficient resources to protect the confidentiality and integrity of the system. Different studies proposed a new operating model to address these issues, with an estimated investment of EUR 30-40 million per year. This investment represents only 0.00016% of the assets held in the Union Registry and would be justified ensuring the integrity and security of the system and integrity of the European carbon market.

Overall, the evaluation confirms that the ETS has successfully achieved its objectives so far and it has been a key instrument in delivering on the EU climate objectives. However, the evaluation also points to areas of improvements, such as better balancing the need to prevent carbon leakage with ensuring continued incentives for investments in decarbonisation, ensure a more efficient MRVA system and enhance the security measures for the Union Registry.

5.2 MSR

The MSR was adopted in 2015 as an instrument with two objectives. First, it aimed to reduce excess allowances in the EU ETS that built up over Phases II and III, as a result of (i) a decrease in demand for allowance due to the 2010 economic crisis and a number of complementary policies, and (ii) an increase in allowance supply through the inflow of international credits into the EU ETS. Second, the MSR aimed to mitigate the build-up of new demand-supply imbalances in order to sustainably strengthen the resilience of the EU ETS.

Since the initial Impact Assessment from 2014, the MSR underwent a number of changes and reforms. The configuration adopted in 2015 was slightly deviating from the parameters assessed in the 2014 IA. In 2018, the intake rate was doubled to increase the effectiveness of the mechanism at reducing the surplus. and an invalidation mechanism was added that introduced a rule-based volume cap for the allowances held in the MSR. This MSR configuration entered into force in 2019. Starting in 2021 with adoption in 2023, the Fit for 55 reform further refined the MSR design. As a results, the 2014 IA can only serve to a limited degree as point of comparison and only for the period from 2014 to 2017, i.e. before the MSR started operating. The MSR Review that the Commission undertook in 2021 is a useful complement for the evaluation.

Effectiveness: The MSR was effective in reducing the historical demand-supply imbalance in the allowance market. The MSR mitigated the build-up of a new imbalance from 2013 but did not fully absorb excess allowances. There is still a demand-supply imbalance. It was hence only partially effective in achieving its second objective to enhance future resilience of the EU ETS market. It was effective in mitigating price crashes resulting from the shocks related to the COVID-19 pandemic and the energy price crisis. Most notably, the MSR credibly signalled the commitment of the EU to the EU ETS, thereby boosting confidence in the market.

Efficiency: The operation of the MSR has few direct costs and large benefits. The evaluation of efficiency concludes however that the MSR induces additional complexity to the EU ETS that is connected with indirect costs for Member States, regulated entities, and other stakeholder engaging in modelling, price forecasts or any other assessment of the functioning of the EU ETS.

Coherence: The evaluation of MSR coherence concludes that the MSR is largely coherent with complementary policies as it addresses the waterbed effect. In some instances,

counterintuitive interactions with complementary policies have occurred, such as REPowerEU and voluntary cancellation, but these have been effectively addressed.

In sum, while the MSR added complexity to the EU ETS regarding the calculation of allowance supply in a given year as well as the interaction with complementary policies, the evaluation attests to the instrument's positive effect on reducing demand-supply imbalances in and increasing overall confidence into the EU ETS, thereby making it more resilient to future shocks.

6 APPENDIX I. PROCEDURAL INFORMATION

See Annex 1 on Procedural Information

7 APPENDIX II. METHODOLOGY AND ANALYTICAL MODELS USED

This Evaluation has not carried out economic modelling but has studied the literature for ex post economic modelling and econometric analysis, supplemented by stakeholder interviews and own analysis. The details are given in Appendix III as well as the body of the Evaluation.

For the EU ETS as an instrument to attain a certain ambition level cost-effectively, it is extremely challenging to dis-entangle the impacts of the carbon price, which was rather low over much of the period, from the impacts of financial crisis, the COVID-19 Pandemic, and the energy price crisis due to the Russian invasion of Ukraine, taking part against the background of a secular shift from manufacturing to Services in Western economies, and the rise of the Chinese economy. All of these elements have a very large impact on the economy as a whole.

Nevertheless, in so far as academic literature has been available, it has been cited in the body of the Evaluation. It needs to be emphasised here that all econometric or ex post modelling literature suffers from the uncertainties inherent to dis-entangling the impacts of climate policy from much larger economic crises or megatrends. While general conclusions can be drawn, full quantification is unreliable, and these past results should not be extrapolated to the future. For this reason, the evaluation has taken a pragmatic approach, using external knowledge and a well-circumscribed analysis of available data, with the necessary caveats.

For assessing the effectiveness and efficiency of the EU ETS as a whole, the Evaluation cited economic studies in the literature and drew conclusions from available data about emissions per sector, carbon prices and energy prices.

For the Market Stability Reserve a “Baseline” was retro-actively constructed by arithmetically calculating what the surplus (TNAC) in the market would have been without an MSR active. While this leaves out the dynamic impacts of the MSR on price and on reductions, it provides a straightforward way to show its impacts. The Baseline from the Impact Assessment in 2014 is too outdated to use, given that policy intensity has been higher and economic developments since 2020 have been dramatically different. The Reference Scenario from 2014 is more relevant but possesses similar drawbacks. The analysis based on the straightforward counterfactual Baseline has been further strengthened by considering the way the carbon market has responded to recent shocks, consulting stakeholders as well as literature.

The analysis on carbon leakage used academic literature as well as stakeholder interviews to get external views on the effectiveness of carbon leakage measures so far, as well as the possible occurrence of carbon leakage in the past. The extent of free allocation for different sectors, how this changed from Phase III and Phase IV, and the impact thereof on carbon costs, was estimated based on the emissions and activity data submitted by operators, as part of the application for free allocation for 2026-2030. The administrative costs for the monitoring, reporting, verification, as well as free allocation processes were determined based on data collected from operators, verifiers and competent authorities via a dedicated survey.

8 APPENDIX III. EVALUATION MATRIX AND DETAILED EVALUATION OF THE EU ETS COMPONENTS (BY CRITERION)

8.1 EU ETS Evaluation Matrix

8.1.1 Effectiveness

Table 1: ETS Evaluation Matrix – Effectiveness

	Sub-questions	Judgment criteria	Indicators and approach	Data sources
2a	What were the overall emissions reductions associated with the EU ETS sectors?	If the quantitative assessment shows that emissions have declined over the 2018-23 period, then emission reductions have occurred.	Quantitative assessment: • Show overall emission reduction between 2014 up until 2023 based upon NIMs data and compare with EUTL values.	EUTL NIMs Build upon the work already undertaken for carbon leakage evaluation.
2b	To which extent can the emissions reductions (if observed) be attributed to the application of the Directive?	If the carbon price has increased to levels that incentivise realisation of abatement potential and sectors are more exposed to the carbon price signal then the ETS has driven, at least in part, the emission reductions observed.	Quantitative / qualitative assessment • Show the balance of allowances compared to verified emissions based on EUTL data and discuss ETS and non-ETS factors that could drive the observed trend. • Show carbon price development based on EEX data. • Refer to work undertaken for carbon leakage chapter to outline the share of emissions covered by free allocation. • Show CO_2 cost impact on electricity prices	EUTL EEX Literature review Interviews

			• Refer to work undertaken for carbon leakage chapter to outline the support provided for indirect cost compensation. • Refer to work undertaken for carbon leakage on specific emission improvements of product BMs. • Refer to interviews to add insight on role of ETS on the changes in specific emissions observed and how the carbon price is influencing abatement. Qualitative assessment: • Literature review of studies that assess the role of ETS in driving emission reductions.	
2c	How do the observed effects correspond to the objectives of the Directive?	If the emission levels are in line with the ETS cap, then the observed effects correspond to the objectives of the Directive. If there is no evidence of carbon leakage, then the observed effects correspond to the objectives of the Directive with regards to a 'high level of environmental protection.' If there is evidence of investments in low carbon technology, then that the observed effects correspond to the objectives of the Directive.	Quantitative assessment: • Compare the emission levels over the 2014-23 with the ETS cap. • Show evidence of carbon leakage (refer to more detailed analysis under carbon leakage) • Show effect on investments (refer to more detailed analysis under carbon leakage) Qualitative assessment: • Refer to ongoing studies from EEA to validate quantitative results.	Progress on climate action - European Commission Carbon Market Report EEA trends and projections report
2d	Has the revised ETS Directive been successful in improving the functioning and the resilience of the carbon	If the surplus of allowances has been reduced since the start of Phase III, then the MSR reforms and increasing the LRF has been successful.	Refer to more detailed chapters of the evaluation: • Refer to effectiveness under the MSR chapter.	More detailed work in subsequent chapters.

	market by addressing the surplus of allowances (which was identified in Phase III) by strengthening the MSR and increasing the LRF?			
2e	Has the EU ETS MRVA system supported the overall effectiveness of the EU ETS?	The MRVA system ensured accurate, complete and transparent emissions data, as well as prevented errors or misreporting.	Quantitative assessment: • MRVA survey results assessment Qualitative assessment: • Assessment of Member States Article 21 reports	Survey results Article 21 Reports
2f	Has the EU ETS auctioning system supported the overall effectiveness of the EU ETS?	The auctioning system operated in an open, transparent and predictable manner and ensured the reliable allocation of emission allowances to market participants and the transfer of auction proceeds to the auctioneers.	Quantitative assessment: • Auction bidder participation rates, number of cancellations, etc. Qualitative assessment: • ESMA assessment of the functioning of the carbon market	ESMA report EEX reports Article 10(4) reports
2g	Has the EU ETS registry system supported the overall effectiveness of the EU ETS?	The Union Registry ensured maintained a reliable and secure IT system for tracking the creation, allocation, surrender and reversal of allowances.	Refer to more detailed chapters of the evaluation: Refer to effectiveness under the Registry Section in Annex III.	More detailed work in subsequent chapters.

8.1.2 Efficiency

Table 2: ETS Evaluation Matrix – Efficiency

	Sub-questions	Judgment criteria	Indicators and approach	Data sources

3a	To what extent has the Directive been more or less successful in achieving its objectives compared to alternatives, e.g. command and control measures, taxation?	Cap and trade is more efficient than alternatives such as regulation of carbon taxes.	Qualitative assessment • Outline the theoretical differences and explain the rationale in favour of cap and trade.	Literature review
4a	To what extent are the costs resulting from the implementation of the Directive proportionate to the changes/effects it has achieved?	If the administrative costs associated with the implementation of the Directive are relatively low, then the costs are proportionate to the changes/effects it has achieved.	Quantitative assessment: • Calculate the total free allocation volume, auctioned allowance volume and verified emissions to all installations in the EU ETS for the years 2014-23 based on EUTL. • Then calculate absolute value based on an average annual carbon price based on EEX. • Show the value of free allocation. • Compare with a counterfactual scenario whereby all allowances would have been auctioned. • Compare value estimated with information to be collected on administrative costs for free allocation application from the survey and insights from interviews and literature review.	EUTL EEX
4b	Has the monitoring, reporting and verification of greenhouse gas emissions covered by the EU ETS been carried out cost effectively and are there any options for simplification are apparent with a view to reduce administrative burden on relevant stakeholders?	The cost of reporting remains proportionate to achieving the objective of accurate reporting.	Quantitative assessment: • Cost of reporting assessed based on MS reporting and survey results	Survey results Article 21 reports

4c	Has the auctioning system been an efficient way of allocating ETS allowances?	Cost of the auctioning process lower than other allocation methods (i.e. free allocation). Auction clearing prices do not significantly deviate from the secondary market	Quantitative assessment: • Auction clearing prices vs secondary market Qualitative assessment: • ESMA assessment of the functioning of the carbon market	ESMA report EEX reports Article 10(4) reports
4d	Has the Registry system been operating in a cost-efficient way?	Registry fees Adequate resources available to operate the Registry securely	Refer to more detailed chapters of the evaluation Refer to effectiveness under the Registry Section in Appendix III.	More detailed work in subsequent chapters.

8.1.3 Coherence

Table 3: ETS Evaluation Matrix – Coherence

	Sub-questions	Judgment criteria	Indicators and approach	Data sources
5a	To what extent is the Directive coherent with other EU policies, such as those related to renewable energy, energy efficiency, state aid, etc.?	If the other climate policies fully support the environmental integrity of the EU ETS and does not impact the ETS cap, then other EU policies are coherent with the Directive. However, overlap may impact the cost of achieving the EU ETS target.	Qualitative assessment: • Build upon the previous evaluation and look for more recent examples of coherence assessments in the literature.	Literature review
5b	To what extent are the various elements of the Directive (such as	If the various elements of the EU ETS hinder the achievement of the objectives of the ETS Directive,	Qualitative assessment: • Review of literature to look at the coherence of free allocation on prevention	Literature review

	free allocation, carbon leakage, innovation support) coherent with one another?	then the design elements are not fully coherent with one another.	of carbon leakage whilst continuing to provide support for innovation. • Review literature to discuss the coherence of the MSR with the EU ETS.	
5c	To what extent is the Directive coherent with international climate policies and obligations?	If the 2030 ETS target is aligned to a trajectory of climate neutrality by 2050 then the Directive is coherent with international climate policies and obligations.	Qualitative assessment: • Refer to Article 4 of the Paris Agreement that requires 'achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century' and compare this with the 2030 target set for the ETS and whether this is aligned with decarbonisation by 2050.	Literature review

8.1.4 EU added value

Table 4: ETS Evaluation Matrix – EU added value

	Sub-questions	Judgment criteria	Indicators and approach	Data sources
4a	What is the EU-value added of the Directive? To what extent could the changes brought by the Directive have been achieved by national or individual Member States' measures only?	If the changes brought by the ETS Directive would most likely be more expensive to implement at the national level, then there is added value of implementation at the EU level.	Qualitative assessment: • Build upon argumentation from previous evaluation and add new relevant insights and reflect more recent changes as examples of the EU added value. • Look also at literature assessing impact of national measures. • Refer to more detailed work on EU added value of rule harmonisation for free	Literature review

			allocation, MRVA and resilience provided by the MSR.	
4b	What would be the most likely consequences of stopping or downscaling the existing ETS Directive?	If the list of potential impacts is likely to be very detrimental then the EU provides a lot of added value that would be at risk if national emission trading systems replaced the EU ETS.	Qualitative assessment: • Build upon argumentation from previous evaluation and add new relevant insights and reflect more recent changes as examples of the EU added value.	Literature review

8.1.5 Relevance

Table 5: ETS Evaluation Matrix - Relevance

	Sub-questions	Judgment criteria	Indicators and approach	Data sources
1a	How well do the objectives of the EU ETS (still) correspond to the EU climate policy objectives? Is the updated objective from the 2018 ETS revision of GHG emissions to be reduced 'in the most economically efficient manner'[131] still relevant?	If the ETS accounts for a considerable share of the emission reduction effort to meet the EU wide targets, then we can argue that the ETS remains relevant.	Quantitative assessment • Compare EU climate target for 2020 and 2030 with verified emissions in the EU ETS. • Share of EU emissions covered by EU ETS 1 and evolution over time. • Number of installations covered by the EU ETS	EUTL NIMs

[131] Refer to para 31 in DIRECTIVE (EU) 2018/ 410 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL - of 14 March 2018 - amending Directive 2003/ 87/ EC to enhance cost-effective emission reductions and low-carbon investments, and Decision (EU) 2015/ 1814. "This Directive seeks to contribute to the objective of a high level of environmental protection, in accordance with the principle of sustainable development, in the most economically efficient manner, while providing installations

1b	Is EU ETS (a cap-and-trade system) still relevant as an effective and efficient instrument for achieving the EU climate policy goals and priorities?	Cap and trade is more efficient than alternatives such as regulation of carbon taxes.	Qualitative assessment: • Refer to discussion provided in detail under efficiency for the EU ETS overall.	Literature review
1c	How well adapted is the Directive to subsequent technological or scientific advances, or any other unexpected external influences such as the recent economic crisis?	If the update of benchmarks have taken account of technological progress and the alignment of free allocation with actual production levels and the introduction and reforms of the MSR has helped the functioning of the ETS in response to unexpected external events, then the changes in the 2018 Directive have helped the ETS to adapt and stay relevant.	Qualitative assessment: • Outline that the ETS is inherently flexible by design but argue that reforms have improved resilience and refer to the following chapters for a more detailed level of argumentation. Refer to more detailed chapters of the evaluation: • We will refer to more detailed discussion of updating product benchmarks in carbon leakage and alignment of free allocation to actual production levels. • We will refer to more detailed discussion of functioning of the MSR to respond to external shocks.	More detailed work in subsequent chapters.
1d	Can the Directive be easily adjusted to new needs, in particular a new GHG target for the EU?	The ETS Directive can be easily adjusted via a change to the LRF to reflect any updates of EU economy-wide ambition.	Qualitative assessment: • Discuss how the LRF was changed in the ETS 2018 Directive to reflect enhanced ambition of EU with 2030 targets.	Review of EU legislation.

adequate time to adapt, and providing for more favourable treatment of particularly affected persons in a proportionate manner to the maximum extent compatible with the other objectives of this Directive."

8.2 MSR Evaluation Matrix

8.2.1 Relevance

Refer to evaluation matrix for the EU ETS overall.

8.2.2 Effectiveness

Table 6: MSR Evaluation Matrix - Effectiveness

	Sub-questions	Judgment criteria	Indicators and approach	Data sources
1a	Did the MSR reduce the total number of allowances in circulation as expected?	• Assessing the development of TNAC from 2013 to 2024. Success: TNAC significantly decreased as expected. • Qualitatively discussing the effect, the effect of EU ETS reform milestones (announcements, adoption, implementation) as well as external factors (economic development, pandemic, energy crisis). • Discussing the MSR effect versus other EU ETS reform elements. • Explaining the realities of the lack of a clear baseline to compare the MSR effectiveness given the number of MSR changes.	TNAC	• TNAC Communications: TNAC, annual allowances supply and verified emissions • Baseline from Impact Assessment and MSR Review • EUA price data
1b	Has the MSR mitigated the buildup of a new surplus?	• Analysing the effects of the MSR on the TNAC during the pandemic 2020/21, the energy crisis 2021/2022 and potential shocks induced by complementary policies (e.g. coal phase-out). • Building upon and potentially update the 2021 IA. • Success: The MSR reduced a buildup of the TNAC compared to a scenario without it. • Discussing the MSR effect and the effect of individual MSR elements versus other EU ETS reform elements.	TNAC	• TNAC Communications: TNAC, annual allowances supply and emissions • Economic activity, energy and EUA price data • MSR Review (2021)

1c	For shocks between 2019 and 2024, has the MSR contributed to mitigating price crashes?	• Analysing the effects of the MSR on the EUA price level during the pandemic 2020/21, the energy crisis 2021/2022 and potential shocks induced by complementary policies (e.g. coal phase-out). • Building upon and potentially update the 2021 IA, incl. the categorisation of shocks. • Success: No building up of a surplus in the period of operations of the MSR. The price level remained stable in times of crises. Shocks have not induced price crashes. • Discussing the effect of the MSR and its individual elements versus other EU ETS reform elements, highlighting that it is impossible to clearly delineate the MSR effect in reality. Using results from existing academic modelling to compare the size of individual effects.	Changes in price level (indicating a healthy demand-supply balance)	• EUA price level • Economic activity, energy and EUA price data • Academic modelling
1d	Has the MSR increased confidence into the EU ETS as main driver for long-term decarbonisation in the EU?	• Assessing how the proposal for the MSR and the invalidation mechanism has been perceived by media, in communications of industry associations, etc. at different reform milestones. Success: positive perception of the MSR/invalidation mechanism in the public opinion. • If possible, discussing the part of price increases attributable to EU ETS fundamentals versus the role of increased confidence.	• Price level (indicating confidence into the system) • Perception of the EU ETS	• EUA price data • Media articles, press releases • Interviews

8.2.3 Efficiency

Table 7: MSR Evaluation Matrix - Efficiency

	Sub-questions	Judgment criteria	Indicators and approach	Data sources
2a	What costs were identified by the 2014 IA?	• Discussing direct and indirect costs for EU administration, MS, and stakeholders, as analysed within the 2014 IA. Discussion of level of these costs. • Direct costs: Low for the EU administration, no direct costs for MS and stakeholders for the implementation of the MSR. • Indirect costs: (as identified in 2014 IA) • Judgement criteria: The 2014 IA had a correct estimation of the identified costs.	Types and level of costs identified in the 2014 IA	• 2014 Impact Assessment
2b	What costs were induced by the MSR that were not foreseen in the 2014 IA?	• Discussing unforeseen direct costs and how they are distributed among stakeholders • Qualitative discussion of indirect costs, e.g. increased complexity in forecasting EUA prices, increased complexity for invalidating allowances alongside a coal phase-out, etc., that appeared within the actual circumstances of MSR implementation. • Judgement criteria: Beyond the 2014 IA no other costs occurred in a significant scale.	Additional cost types and their respective levels	• 2021 Impact Assessment • Academic papers • Targeted interviews
2c	Which of these costs could have been avoided by choosing a different MSR design?	• Analysing potential design choices of the MSR within the fundamental principles of an allowance reserve (threshold parameters and values, speed of reaction). Discussing recent changes like the introduction of the buffer zone to avoid threshold effects. Success: The MSR design is optimal in terms on reducing costs.	Alternative MSR design features	• 2021 Impact Assessment • Academic papers and modelling, policy reports

2d	Did the MSR lead to co-benefits besides the targeted benefits that could not have achieved by other measures?	• Beyond the intended benefits of the MSR (i.e. the reduction of the historical surplus and the increased resilience to future shocks, there are possibly unexpected co-benefits that need to be considered in an evaluation of the MSR efficiency. • Possible co-benefits: further transparency through the publication of the TNAC and its calculation, increased flexibility of the EU ETS through creating a reserve (for reinjecting, invalidation or other purposes), etc. • Judgement criteria: The MSR generated co-benefits that improve its efficiency beyond the original assessment in 2014.	Additional benefits	• Academic papers • Targeted interviews

8.2.4 Coherence

Table 8: MSR Evaluation Matrix - Coherence

	Sub-questions	Judgment criteria	Indicators and approach	Data sources
3a	Is the MSR aligned to other elements of the EU ETS?	• Analysing how other elements of the EU ETS, especially those adjusted in recent reforms (e.g. LRF; 2030 reduction target), might counteract the functioning and objectives of the MSR and vice versa. • E.g., if allowances from the MSR are released in 2030, this might increase emissions and jeopardise the 2030 climate target. • Success: No significant interference between the MSR and other EU ETS elements.	Potential interference between MSR and other EU ETS elements	• 2014 and 2021 Impact Assessments • Academic papers and modelling, policy reports
3b	Is the MSR aligned to other EU climate or energy policies?	• Analysing how EU climate or energy policies might counteract the functioning and objectives of the MSR and vice versa. • Success: No significant interference and ideally synergies between the MSR and other EU climate or energy policies.	Potential interference between MSR and other EU ETS elements	• 2014 and 2021 Impact Assessments • Academic papers and modelling, policy reports • Targeted interviews

3c	Is the MSR in line with to climate or energy policies at Member State level?	• Analysing how climate or energy policies at Member State level counteract the functioning and objectives of the MSR and vice versa. • Particularly, this concerns renewable energy policies, energy efficiency policies and coal-phase outs. • Success: No significant interference and ideally synergies between the MSR and climate or energy policies at Member State level.	Potential interference between MSR and climate or energy policies at Member State level	• 2014 and 2021 Impact Assessments • Academic papers and modelling, policy reports • Targeted interviews

8.2.5 EU Added value

Refer to evaluation matrix for the EU ETS overall

8.3 Carbon Leakage Prevention Evaluation

8.3.1 Introduction

Since the outset of the EU ETS, the allocation of free allowances has served as the main provision for the prevention of carbon leakage, which refers to the possible relocation of industrial production that is subject to EU carbon pricing to countries with less stringent climate policies. Consequently, there is a concern that such unequal carbon pricing may result in either an overall increase in global GHG emissions or a lower reduction in global emissions than in EU emissions.

Already since the start of the EU ETS, the free allocation of allowances was the main instrument used to limit carbon costs and protect against leakage. While this approach helped ease the political and economic transition to a carbon market, it also introduced challenges. Uneven allocation methods across Member States led to distortions in intra-EU competition, and in sectors where allowances were passed through in product prices, companies could gain so-called windfall profits without corresponding environmental benefit. Moreover, the environmental incentive to reduce emissions was often weakened, particularly where free allocation covered most or all of a company's compliance needs.

From Phase III onwards, the share of free allowances declined considerably as more allowances were instead auctioned. The methodology for allocating allowances for free also changed from grandfathering (i.e. based upon historic emissions) to benchmarking that rewarded firms with relatively lower specific emissions for their production by receiving more allowances for free. These reforms to free allocation raised concerns amongst industry about the risk of carbon leakage with less of their emissions covered by free allowances than in previous phases of the EU ETS. However, this potential impact was offset initially by the structural surplus of allowances at the start of Phase III that undermined the price signal of the EU ETS reducing the carbon costs that firms were subject to and, even then, many firms were able to bank their own surplus allowances for later use to hedge themselves against future carbon costs.

In response, the design of free allocation under Phase IV has undergone significant reform to better align with climate ambition, economic fairness, and environmental integrity. The scope of this evaluation for carbon leakage prevention focuses on the key changes that occurred at the start of Phase IV to free allocation following the revision of the ETS Directive in 2018:

- *Revised benchmark values for free allocation:* The introduction of more stringent product benchmarks for free allocation, based on the average performance of the top 10% most efficient installations. This approach strengthens the incentive to improve efficiency and invest in low-carbon technologies, as allowances are increasingly allocated based on demonstrated best performance rather than historical emissions.
- *Updated carbon leakage list:* Phase IV revised the method for identifying sectors at risk of carbon leakage. A quantitative carbon leakage list now applies more rigorous criteria, based on emissions intensity and trade exposure, to determine sectors and sub-sectors that are deemed at a higher risk of carbon leakage. As a consequence of the update to the carbon leakage list, the number of sectors and sub-sectors deemed at risk of carbon leakage was lower than in previous carbon leakage lists and therefore the support in the form of additional free allowances was better targeted.

- *Establishment of a buffer to limit the application of the Cross Sectoral Correction Factor (CSCF)*[132]: If the preliminary allocation of free allowances exceeds the free allocation budget, then the CSCF is applied to reduce the allocation of free allowances by an equal percentage across all installations. The CSCF buffer was introduced to limit the need to apply the CSCF by increasing the number of free allowances that can be made available (up to 3% of allowances that are allocated for auctioning may be used to increase the maximum amount available for free allocation) if the preliminary allocation may exceed the free allocation budget for a given year.
- *Better alignment of free allocation with actual production levels:* the number of free allowances an installation receives is adjusted regularly to reflect actual production levels, rather than being fixed for long periods based on past output. This ensures that free allocation is now more aligned to actual production and that the demand and supply of allowances is more balanced. It also strengthens the economic rationale of the ETS by ensuring that allowance distribution better reflects real-world activity.

The reforms introduced in the latest ETS phase indicate a strategic shift in how the system addresses carbon leakage. Rather than merely shielding the sectors indefinitely from external competition, the updated design encourages innovation while continuing to prevent relocation of emissions and production.

8.3.2 Point of comparison

Provisions of relevance from the 2018 ETS Directive

In the revision to the ETS Directive in 2018, several important reforms were made to the determination of harmonised rules for the free allocation of allowances under Article 10a that will be the focus of this evaluation.

- Harmonised allocation rules for free allocation:

Article 10 (1) provides that the Commission is empowered to adopted "Union-wide and fully harmonised rules for the allocation of allowances". On this basis, Delegated Regulation (EU) 2019/331 was adopted on 19 of December 2018 and further elaborates on the harmonised allocation rules outlined in Article 10a of the ETS Directive.

- Revised benchmark values for free allocation:
  Article 10a, paragraph 2 was updated as follows:
  - "For the period from 2021 to 2025, the benchmark values shall be determined on the basis of information submitted pursuant to Article 11 for the years 2016 and 2017. On the basis of a comparison of those benchmark values with the benchmark values contained in Commission Decision 2011/278/EU (*), as adopted on 27 April 2011, the Commission shall determine the annual reduction rate for each benchmark, and shall apply it to the benchmark values applicable in the period from 2013 to 2020 in respect of each year between 2008 and 2023 to determine the benchmark values for the period from 2021 to 2025"
  - "Where the annual reduction rate exceeds 1,6 % or is below 0,2 %, the benchmark values for the period from 2021 to 2025 shall be the benchmark values applicable in the period from 2013 to 2020 reduced by whichever of

[132] The Cross Sectoral Correction Factor (CSCF) is used to prevent free allocation exceeding the free allocation budget and is applied to preliminary allocation to determine the final allocation.

those two percentage rates is relevant, in respect of each year between 2008 and 2023."

- "By way of derogation regarding the benchmark values for aromatics, hydrogen and syngas, these benchmark values shall be adjusted by the same percentage as the refineries benchmarks in order to preserve a level playing field for producers of those products….In order to promote efficient energy recovery from waste gases…the benchmark value for hot metal, which predominantly relates to waste gases, shall be updated with an annual reduction rate of 0,2 %."

Implementing Regulation (EU) 2021/447 was adopted on the 12th of March 2021, which determined the revised benchmark values for free allocation of emission allowances for the period from 2021 to 2025.[133]

- Establishment of a buffer to prevent the application of the CSCF:
  Article 10a, paragraph 5 is replaced by the following:
  - "In order to respect the auctioning share, set out in Article 10, for every year in which the sum of free allocations does not reach the maximum amount that respects the auctioning share, the remaining allowances up to that amount shall be used to prevent or limit reduction of free allocations to respect the auctioning share in later years. Where, nonetheless, the maximum amount is reached, free allocations shall be adjusted accordingly. Any such adjustment shall be done in a uniform manner.'

The following paragraph was subsequently inserted:

- By way of derogation from paragraph 5, an additional amount of up to 3 % of the total quantity of allowances shall, to the extent necessary, be used to increase the maximum amount available under paragraph 5.

- Better alignment of free allocation with actual production levels:
  Article 10a, paragraph 20 was replaced by the following:
  - "The level of free allocations given to installations whose operations have increased or decreased, as assessed on the basis of a rolling average of two years, by more than 15 % compared to the level initially used to determine the free allocation for the relevant period referred to in Article 11(1) shall, as appropriate, be adjusted. Such adjustments shall be carried out with allowances from, or by adding allowances to, the number of allowances set aside in accordance with paragraph 7 of this Article"

Implementing Regulation (EU) 2019/1842 was adopted on the 31st of October 2019, which outlined the rules for the further arrangements for the adjustments to free allocation of emission allowances due to activity level changes.[134]

In the revision to the ETS Directive in 2018, several important reforms were made to the transitional measures to support certain energy intensive industries in the event of carbon leakage under Article 10b that will be the focus of this evaluation.

- Updated carbon leakage list:

[133] Implementing regulation (EU) 2021/447, available at: https://eur-lex.europa.eu/eli/reg_impl/2021/447/oj

[134] Implementing regulation (EU) 2019/1842, available at: eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R1842

Article 10b, paragraph 1, was replaced as follows:

- "Sectors and subsectors in relation to which the product resulting from multiplying their intensity of trade with third countries, defined as the ratio between the total value of exports to third countries plus the value of imports from third countries and the total market size for the European Economic Area (annual turnover plus total imports from third countries), by their emission intensity, measured in $kgCO_2$, divided by their gross value added (in EUR), exceeds 0,2, shall be deemed to be at risk of carbon leakage. Such sectors and subsectors shall be allocated allowances free of charge for the period until 2030 at 100 % of the quantity determined pursuant to Article 10a."

Delegated Decision (EU) 2019/708 was adopted on the 15th of February 2019, which determined the sectors and subsectors deemed at risk of carbon leakage for the period 2021 to 2030.[135]

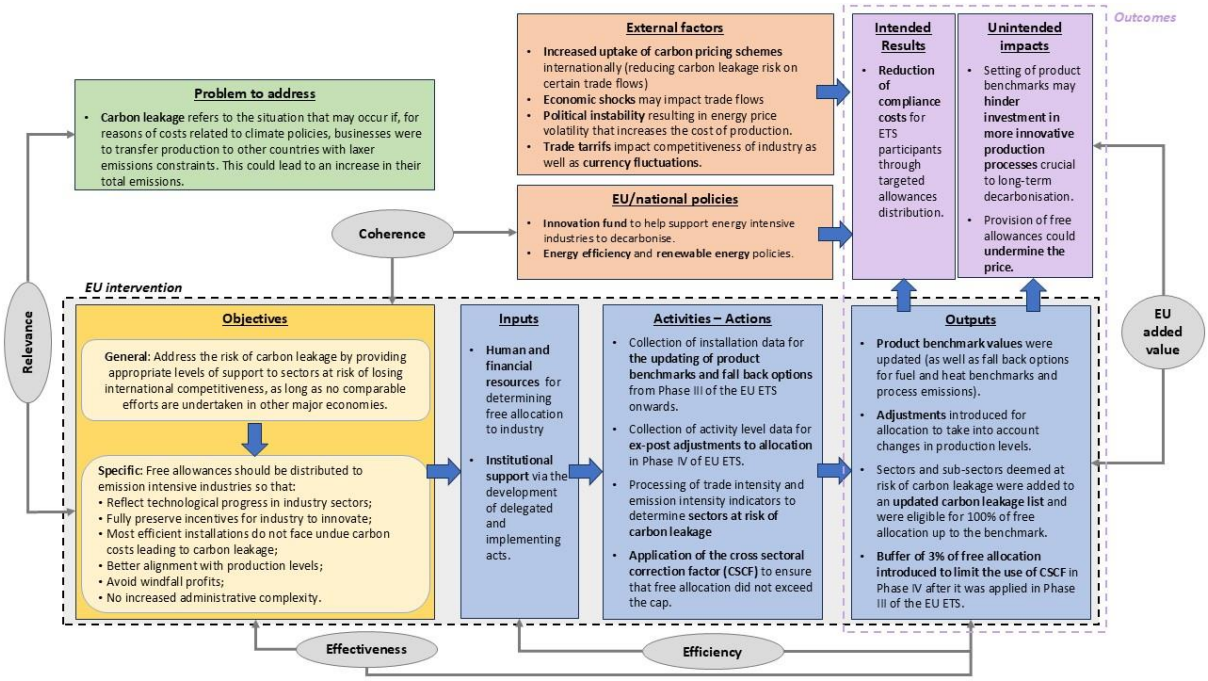
The reforms to free allocation outlined above following the revision to the ETS Directive in 2018 were all intended to better target free allocation to sectors at risk of carbon leakage. The next section explains further via an intervention logic diagram how the collective policy interventions were intended to be implemented in theory before subsequently evaluating whether this materialised in practice based on recent empirical evidence.

8.3.3 Intervention logic

Figure 19 provides an overview of the intervention logic to justify the provision of free allocation in order to prevent the occurrence of carbon leakage. The intervention logic diagram focuses on the point of comparison, which as explained in the previous section, refers to the reforms made to the provision of free allocation following the revision to the ETS Directive in 2018. The extent to which the policy intervention delivered the expected outcomes will be the subject of the evaluation responding to the questions set in the corresponding evaluation matrix. Each element of the intervention logic diagram below is further discussed in the following subsections.

[135] Official Journal of the European Union, Volume 62, 8 May 2019, available at: eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L:2019:120:FULL

Figure 19: Intervention logic diagram (carbon leakage)



Source: Own illustration

8.3.3.1 Problem to address

The prevention of carbon leakage, which refers to the possible relocation of industrial production that is subject to EU carbon pricing to countries with less stringent climate policies. Therefore, there is a concern that such unequal carbon pricing may result in either an overall increase in global GHG emissions or a lower reduction in global emissions than in EU emissions. As a consequence, unequal carbon pricing across jurisdictions abroad presents a competitive challenge for European producers covered by the EU ETS.

Carbon leakage poses economic risks, including the potential decline of industrial activity, jobs and market share, and also undermines the climate objectives of the EU ETS. Addressing this concern is central to the EU's overall climate strategy and becomes increasingly relevant as the ambition of the EU ETS progressively increases over time.

8.3.3.2 Objectives

The primary instrument to protect emission intensive industries against the risk of carbon leakage was free allocation. Through free allocation, a portion of allowances is allocated for free to carbon intensive sectors exposed to the risk of carbon leakage, in order to prevent relocation of activity to areas without a carbon price.

Indeed, the **general objective** of the provision of free allocation is to prevent the risk of carbon leakage by shielding emissions-intensive and trade-exposed industries from the full cost of

compliance of the EU ETS. The design of the policy intervention is underpinned by the following two **specific objectives**[136]:

- the more targeted provision of free allowances to continue "effective protection for sectors exposed to a significant risk of carbon leakage".
- to incentivise "the uptake of low carbon technologies" to reduce their exposure to the carbon price in the longer term.

A common critique of free allocation in the EU ETS is that it reduces the incentive for emissions-intensive industries to decarbonize by shielding them from the full carbon price. This can delay or reduce incentives for these industries to shift to lower-emission technologies, as they face less financial pressure to cut emissions. In theory, however, the EU ETS still encourages decarbonisation because companies can sell any surplus allowances if they lower their emissions below allocated levels, thereby earning a profit. Furthermore, reforms to how free allocation is provided (i.e. the introduction of benchmarking) ensures that incentives remain to reward firms for taking early action to reduce their emissions by securing more allowances that they can sell in the future. Nonetheless, critics argue that this profit potential is often not strong enough to overcome the benefit of maintaining current, higher-emission processes when firms receive allowances at low or no cost.

The extent to which the objectives above address the identified problem are defined as the relevance of the policy intervention. The ambition of the EU ETS has been raised further in Phase IV to align with the goal of achieving climate neutrality by 2050, set by the European Green Deal. As a consequence, concerns regarding carbon leakage have continued to grow in recent years as the price signal has strengthened in response to, in part, the enhanced levels of ambition of the EU ETS.

8.3.3.3 Inputs

Implementing the reforms for the more targeted provision of free allocation in Phase IV required significant **human and financial resources** from the Commission, Member States, and relevant institutions. The use of these resources is discussed in the next subsection providing examples of the subsequent actions.

8.3.3.4 Actions

With significant human and financial resources from the Commission, Member States and other relevant institutions, the following actions were undertaken:

- The *updating of the product benchmarks and fall-back options* by taking into account more recent NIMs data[137] on emissions and activity levels for installations (that needed to be collected, verified and processed) to make the

[136] COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT REPORT Accompanying the document DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union, Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and Regulation (EU) 2015/757, https://eur-lex.europa.eu/legal-content/EN/AUTO/?uri=celex:52021SC0601

[137] Data collected/submitted to the COM in accordance with Art. 11 of the ETS-D and FAR Art. 14.

necessary adjustment to the product benchmark values and fall-back options that were applied previously in Phase III.[138]

- *Determining whether the CSCF needed to be applied* to ensure that final free allocation did not exceed the EU ETS cap even with the establishment of the additional buffer. This involves further resource to compare the cap and auctioning share with the total preliminary allocation before multiplying it by the CSCF to calculate the total final allocation that was subsequently approved and published by the Commission. The establishment of an additional buffer also required resources to design, review and approve.
- Setting rules for the Activity Level Changes Regulation (ALCR)[139] and to then adjust allocation to reflect changes in activity levels**.** This required resources to maintain free allocation levels that were more aligned to actual production levels.
- The *determination of the carbon leakage list* involved detailed assessments of trade intensity and emissions exposure across industrial sectors and required dialogue with key stakeholders. The methodology for the first level quantitative assessment was revised with a single carbon leakage indicator (i.e. emission intensity * trade intensity) used to determine the sectors and sub-sectors at significant risk of carbon leakage and this required considerable resources to design, review and approve. The eligibility criteria for a second level assessment at a more disaggregated level was also revised to reflect the use of a single carbon leakage indicator.

8.3.3.5 Output

The actions described above resulted in the following outputs:

- *Updated benchmark values* for Phase IV (2021-25) were calculated based upon NIMs data, which was collected by the Commission in 2019, related to the emissions and activity levels of all sub-installations. The benchmark values from Phase III were adjusted downwards to reflect the technological improvements observed in the NIMs dataset.
- *No application of the CSCF*: In Phase III, the application of the CSCF resulted in a reduction in free allocation of approximately 6% in 2013 and 18% in 2020.[140] In Phase IV (2021-25) the CSCF was not applied and remained at 1 because of the preliminary allocation not exceeding the available quantity of free allowances.
- *Rules for aligning allocation better to activity levels*: Rules were set for adjustment to allocation levels in Phase IV to be more aligned with actual production.

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[138] The key activities involved the collection of detailed emissions and activity data from industrial installations to establish benchmark values. These benchmark values, which represented the average emissions of the top 10% most efficient installations, were used as the basis for calculating free allocation. For Phase III of the EU ETS, 52 product benchmarks and two fall-back values were established. The fall-back options are benchmarks for heat and fuel consumption for product and processes covered by the product benchmark. The collection of benchmark data was organised on a voluntary basis and based on a methodology set out by the European Commission.

[139] Implementing regulation (EU) 2019/1842, available at: https://eur-lex.europa.eu/eli/reg_impl/2019/1842/oj/eng

[140] EU ETS Cross Sectoral Correction Factor

- *More targeted carbon leakage list*: Sectors and sub-sectors that met the criteria for significant risk of carbon leakage were added to a carbon leakage list and were eligible for 100% of the quantity of free allowance determined pursuant to Article 10a of the ETS Directive. The resulting carbon leakage list was more targeted due to the use of a single carbon leakage indicator to determine the carbon leakage risk status of sectors and sub-sectors.

8.3.3.6 Intended results

The policy intervention intended to provide emission-intensive and trade-exposed sectors with a degree of protection from the full cost of carbon pricing under the EU ETS. By providing a targeted allocation of free allowances to sectors at significant risk of carbon leakage, it aimed to limit compliance costs and prevent relocation of industry. At the same time, it was expected that the use of benchmarks and gradual adjustments to allocation rules would preserve incentives for emissions reductions and innovation. In this way, the intervention sought to balance competitiveness and climate objectives.

8.3.3.7 Unintended impacts

Free allocation can result in lower carbon prices, which could undermine the strength of the EU ETS price signal and the efficiency of the system. The updated benchmark values for Phase IV, better alignment of allocation to production levels and a revised carbon leakage list all help to ensure that free allocation is better targeted and this offsets the unintended impact of free allocation on the lowering of carbon prices.

Another unintended impact of the provision of free allocation, albeit better targeted, is that it may still delay investments in more innovative production processes as installations that continue to receive free allowances are not fully exposed to the carbon cost. However, the allocation of free allowances based upon benchmarking has helped to mitigate this unintended impact by linking the allocation of free allowances to performance in terms of the emission intensity of production for benchmarked products. However, even with the use of product benchmarks, innovation can still be disincentivised if a product benchmark fails to take into account new technologies within its product boundary. This has already been acknowledged and started to be addressed by the Commission with some product benchmark definitions being modified - most notably those related to hydrogen and steel production.[141]

8.3.3.8 External factors

The effectiveness of carbon leakage provisions has been influenced by external developments. At the international level, the increase in the international uptake of carbon pricing schemes could reduce the impact of carbon leakage on certain domestic industries and trade flows. According to ICAP,[142] 36 ETS systems are currently in force at a global level, and 22 systems are under stages of development and consideration. Industrial influences include macroeconomic shocks, which can impact trade flows; geopolitical instability, which could result in energy price volatility and increase costs of production for emissions intensive industries; trade tariffs and currency fluctuations can impact trade flows and the competitiveness of EU industries.

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[141] REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL on the functioning of the European carbon market in 2023, SWD(2024) 264 final

[142] Emissions Trading Worldwide: 2024 ICAP Status Report | International Carbon Action Partnership

8.3.3.9 EU/national policies

The intervention interacts with several related EU and national policies. At the EU level, instruments such as the Innovation Fund, established by the Directive 2003/87/EC, promotes financial support for emission-reducing investments and can support emission intensive industries' efforts to decarbonise. Likewise, the Energy Efficiency Directive (Directive (EU) 2023/1791) and the Renewable Energy Directive (Directive (EU) 2023/2413) aim to reduce overall energy demand and increase the share of renewables, thereby indirectly reducing emissions and the demand for ETS allowances.

Member States' National energy and climate plans (NECPs) outline how each Member State plans to achieve its climate goals by 2030. NECPs include information on energy efficiency and innovation, which could affect industrial emissions. Member States' energy strategies and renewable targets can affect emissions reduction. The coherence and interplay between these policies are essential to ensure that carbon leakage provisions remain effective while supporting the Union's wider climate policy objectives.

8.3.4 Evaluation findings

8.3.4.1 Effectiveness

The effectiveness of free allocation as measure for reducing the risk of carbon leakage is evaluated on the basis of the following questions:

- EQ1: Has free allocation been an effective measure in Phase IV to protect against carbon leakage considering the targets of the enhanced emissions reduction?

In recent years, industrial producers in Europe have been operating in an increasingly uncertain and volatile environment following a succession of unforeseen external events that included the supply chain impacts of the COVID-19 pandemic, the spike in energy prices following the illegal invasion of Ukraine by Russia and the imposition of higher trade tariffs by the United States. Over the same period, the EUA price has risen sharply reaching in excess of EUR 80 early into Phase IV of the EU ETS. As a consequence, the cost of compliance for European producers that do not have banked allowances from previous phases of the EU ETS has increased considerably. During interviews with a range of industrial stakeholders there was an acknowledgement that carbon pricing was not the main driver influencing the competitiveness of EU industry, however, it was strongly argued that the additional unilateral costs associated with the increased EUA price has exacerbated what was already a very challenging situation for European producers.

The risk of carbon leakage depends upon two factors:

- Exposure of EU producers to the carbon cost.
- Extent of comparable carbon pricing in third countries.

EU industrial producers have not yet fully decarbonised, so they remain exposed to the carbon cost and, comparable carbon pricing in third countries has overall not yet materialised. The provision of free allocation to industry was therefore continued into Phase IV of the EU ETS, still as a transitionary measure, to reduce compliance costs to protect European industry from the risk of carbon leakage. There was a consensus from the interviews with industrial stakeholders that free allocation has been effective in preventing carbon leakage, although many suggested that the effectiveness of free allocation has declined following the Phase IV reforms to free allocation rules (especially with regards to the reduction of the product benchmark values).

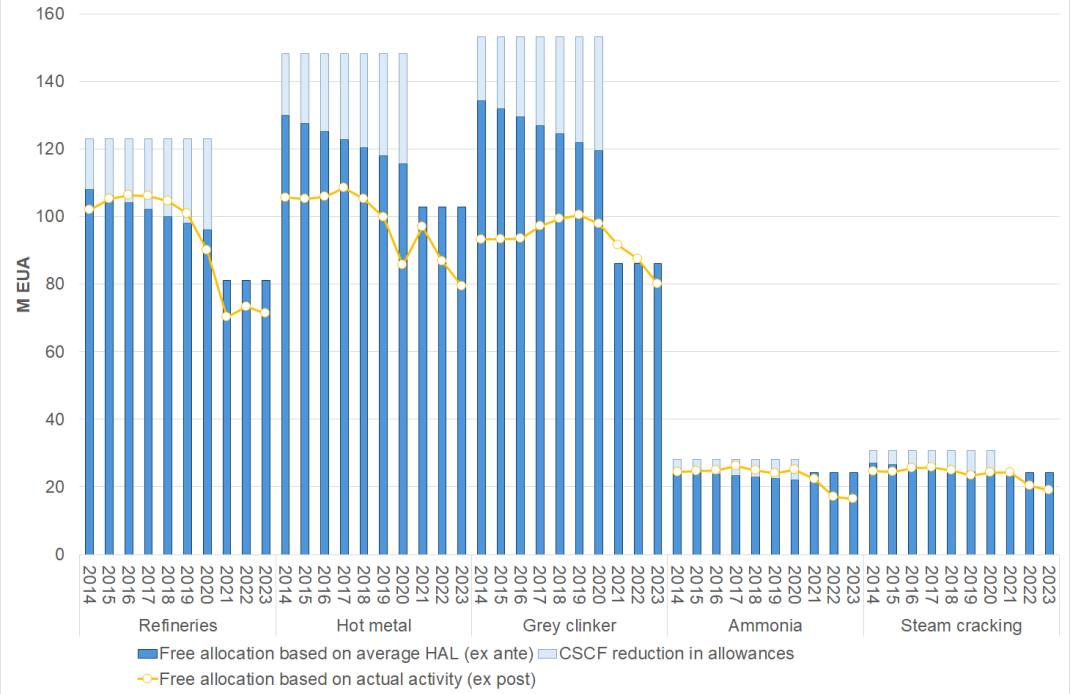
In terms of the volume of free allocation, it is the case that overall levels have been reduced in Phase IV compared to Phase III because of the reforms to free allocation that were implemented (i.e. mainly related to the reduction in the product benchmark values).

Figure 20 shows that there is a considerable reduction in the level of free allocation provided at the start of Phase IV for the most emission intensive product benchmarks compared to previous levels of free allocation provided in Phase III. This reduction in free allocation in Phase IV compared to Phase III reflects the fact that 1) the product benchmark values have been reduced and 2) the historical average activity level used to determine the volume of free allocation in Phase IV was significantly lower. This represents a cost to industrial stakeholders as a consequence of the reforms to free allocation that were implemented from Phase IV of the EU ETS onwards as a greater share of their verified emissions were not covered by free allowances. Industrial stakeholders consistently argued in interviews that the reforms to free allocation in Phase IV have reduced the effectiveness of free allocation to protect against carbon leakage based upon the logic that overall volumes of free allocation are now lower and that the carbon price is significantly higher. However, the impact of the reforms to free allocation in Phase IV is likely to be offset by the allowances banked by industrial producers from Phase III.

As part of the evaluation, levels of free allocation were recalculated based on actual activity data from the NIMs dataset and this shows that in practice the number of allowances provided to industry were considerably higher based upon the historical ex-ante values (prior to the economic recession of 2008/9) used to determine free allocation levels in Phase III. Therefore, the number of allowances available between 2013 and 2020 (even after a reduction following the application of the cross sectoral correction factor)[143] was still in many cases higher than the free allocation that was recalculated based on actual activity levels. It is evident from this quantitative analysis that the exposure to the carbon price has increased across industrial sectors due to the revision to free allocation lowering volumes in Phase IV, but it is still very likely that, in the short term, at least some of these impacts can be offset by the volume of free allowances that were banked from the previous phase.

[143] The values were based on the update of the CSCF according to Annex II Commission Decision (EU) 2017/126 of 24 January 2017 amending Decision 2013/448/EU as regards the establishment of a uniform cross-sectoral correction factor in accordance with Article 10a of Directive 2003/87/EC of the European Parliament and of the Council. This is likely to over-estimate the impact of the application of the CSCF as in practice volumes of free allocation prior to 2017 were not retrospectively changed considering this decision.

Figure 20: Comparison of the free allocation provided to sub-installations[144] via emission intensive product benchmarks with ex-ante[145] and ex-post activity[146] levels



Source: Preliminary NIMs dataset (2025), COM publication on average HAL to determine free allocation volumes in Phase III f0360f59-5fd0-4d08-933b-eb12cd2cfc9a_en, Own calculation.

During the interviews with industrial stakeholders, the starting point for many of the discussions was to first reach an understanding concerning the carbon cost of production and how this has developed over time. The difference between the benchmark value of a product and the average specific emissions associated with the production of each benchmarked product will, in theory, determine the additional carbon cost. The argument consistently advanced by the industrial stakeholders was that the emissions not covered by free allocation for the production of benchmarked products has increased due to the reduction in the benchmark values in Phase IV and that the cost of compliance has increased considerably due to the sharp rise of the EUA price in recent years and that therefore free allocation is less effective than in the past at protecting industry from the risk of carbon leakage.

Table 9 provides an overview of the estimated carbon cost per unit of output for a selection of benchmarked products because of the 2016/17 average specific emissions[147] being higher than the benchmark value set for the 2021-25 period. The difference is the specific emissions not

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144 Sub-installations were only included if NIMs data on historic activity level was available for both the 2014-18 and 2019-23 to ensure a consistent dataset across the period.

145 The ex-ante free allocations for Phase III and Phase IV were estimated by multiplying the relevant product benchmark by the corresponding average historical activity level for 2008-09 (based on aggregated production data published by the COM (refer to f0360f59-5fd0-4d08-933b-eb12cd2cfc9a_en) and 2014-18 (based on aggregated historical activity levels from the NIMs dataset) respectively and this was then subsequently multiplied by the annual CSCF across each year of the time period.

146 The ex-post free allocations for Phase III and Phase IV were estimated by multiplying the aggregated historical activity levels from the NIMs dataset with the corresponding product benchmark over the 2014-23 period and this was then subsequently multiplied by the annual CSCF across each year of the time period.

147 Average specific emissions for 2016/17 were estimated based on the values previously calculated by the COM using the NIMs dataset (refer to policy_ets_allowances_bm_curve_factsheets_en.pdf)

covered by free allocation and this amount was therefore subject to a carbon cost (based on an EUA price assumption of EUR 80). Industry often cited higher average specific emissions during the interviews in order to argue higher carbon costs per tonne but it is likely that the carbon cost were actually lower than those outlined in Table 9, as the preliminary NIMs data assessed for this evaluation shows that there has in fact been further improvements in average specific emissions across the benchmarked products since the 2016/17 values were published by the Commission.

Table 9: Carbon cost per tonne (assuming an EUA price of 80 EUR) across selected benchmarked projects based upon a comparison of the 2021-25 BM value with average 2016/17 specific emissions

BM	BM Unit	BM (2021-25)	2016/17 AVG	Diff.	Carbon cost (EUR/t or CWT)
Refinery products	t CO_2e/CWT	0.0228	0.033	0.0102	1
Hot metal	t CO_2e/t	1.288	1.520	0.232	19
[Primary] Aluminium	t CO_2e/t	1.464	1.681	0.217	17
Grey cement clinker	t CO_2e/t	0.693	0.818	0.125	10
White cement clinker	t CO_2e/t	0.957	1.097	0.14	11
Lime	t CO_2e/t	0.725	1.034	0.309	25
Dolime	t CO_2e/t	0.815	1.177	0.362	29
Sintered dolime	t CO_2e/t	1.406	1.525	0.119	10
Float glass	t CO_2e/t	0.399	0.514	0.115	9
Bottles & jars (colourless glass)	t CO_2e/t	0.29	0.481	0.191	15
Bottles & jars (coloured glass)	t CO_2e/t	0.237	0.391	0.154	12
Ammonia	t CO_2e/t	1.57	1.972	0.402	32
Steam cracking	t CO_2e/t	0.681	0.891	0.21	17

Source: policy_ets_allowances_bm_curve_factsheets_en.pdf, Own calculation.

In the interviews, industrial stakeholders often cited higher carbon costs per unit of production (often referring to different categories of products than those benchmarked or simply by referencing different average specific emissions). These inputs were intended as transparent calculations based on a set of assumptions by industrial associations to helpfully provide a scale

of the carbon cost. Several sector examples are provided below with an explanation for the main reasons for differences with the previous calculation using a different approach outlined in Table 9:

- *Eurofer* estimated carbon cost for crude steel production of around EUR 25 to 30 per tonne based upon an average emission intensity of 1.8 tCO_2 per tonne of primary crude steel to argue that around 0.36 to 0.45 tCO_2 per tonne of output were fully exposed to the carbon price. The cost price for a tonne of crude steel varies and a value was not provided during the interview but based on secondary literature the carbon cost share could represent around 5 to 7% based on a cost price of EUR 458 per tonne for crude steel produced via the integrated route.[148] The value provided by Eurofer is considerably higher than the value calculated in Table 9 and this is primarily driven by the fact that a higher specific average emission was assumed for crude steel than what was published as an average 2016/17 for specific emissions for hot metal production.
- *Fertilisers Europe* based their estimation of the carbon cost on the average specific emissions of ammonia production of 2 tCO_2 per tonne of output and suggested that the carbon cost was EUR 50 per tonne of ammonia (if 0.5 tCO_2 per tonne of output was above the benchmark and subject to a carbon price of EUR 100). Given that the price of ammonia per tonne is around EUR 400 per tonne it was argued that the carbon cost component accounted for a 12.5% share of the product price in Phase IV. The value provided by Fertiliser Europe is considerably higher than the value calculated in Table 9 and this reflects a higher carbon price assumption and specific average emissions that are assumed to be higher than what was published as an average 2016/17 for specific emissions for ammonia production.
- *Cement Europe* estimated the carbon cost of production based on the average performance of a clinker installation being 0.820 tCO_2 per tonne of clinker output. Given that the cost price for a tonne of cement is around EUR 80 to 90 , making further assumptions on both the ratio of clinker in cement (i.e. 75%) and the carbon price (i.e. 70 EUR per tonne). Cement Europe estimated that the carbon cost accounted for between 6 and 15 % of the total cost price a tonne of cement, which was cited as being around EUR 80 to 90 . The value provided by Cement Europe is not directly comparable with the calculation above in Table 9 as it refers to cement rather than cement clinker but again their higher value is driven by an assumed higher average specific emission that what was published as an average for 2016/17
- *Eurometaux* provided information on the full carbon cost exposure without free allocation citing a much higher average specific emission value for primary aluminium production than what was published as an average specific emission value for 2016/17 as shown in Table 9. The low carbon cost calculated for primary aluminium reflects that the average 2016/17 specific emissions are only slightly higher than the benchmark value, so it is assumed that a very low share of emissions is exposed to the carbon price. In contrast, the calculation provided by Eurometaux does not consider the share of emissions currently covered by free allocation. They stated during the interview that primary aluminium production emits around 2 tCO_2 per tonne of aluminium. Assuming an ETS price of 70 EUR/t, the ETS increases the cost of producing primary aluminium

[148] Refer to https://www.eurofer.eu/assets/news/eu-technical-report-on-production-costs-from-the-iron-and-steel-industry-in-the-eu-and-third-countries/production_costs_from_the_iron_and_steel_industry_-_final_online.pdf

in Europe by 140 EUR/t. This is equivalent to 6% of the global price for a tonne of aluminium set at the London Metal Exchange (currently 2600 $/t = 2222 EUR/t).

- *Fuels Europe* did not provide an estimate of the carbon cost directly but instead stated that the sector has experienced a consistent shortage (around 30%) in the number of allowances to cover their verified emissions.

The industrial stakeholders that were interviewed frequently praised the role of free allocation in partly offsetting the full carbon cost, which in their opinion cannot be passed through due to exposure to international competition. While the ability to pass through costs is likely to vary across industrial sectors, all the industrial stakeholders argued that free allocation was necessary to offset the impact of a unilateral carbon cost that is simply not faced by international competitors.

A key question then arises, has the reduction in free allocation that has been observed in Phase IV led to carbon leakage? If carbon leakage was to have occurred, in the short term, it is likely that the following trends would have materialised:

- Activity levels would have reduced (as production re-located outside of the EU).
- Imports would have increased.
- Exports would have declined.

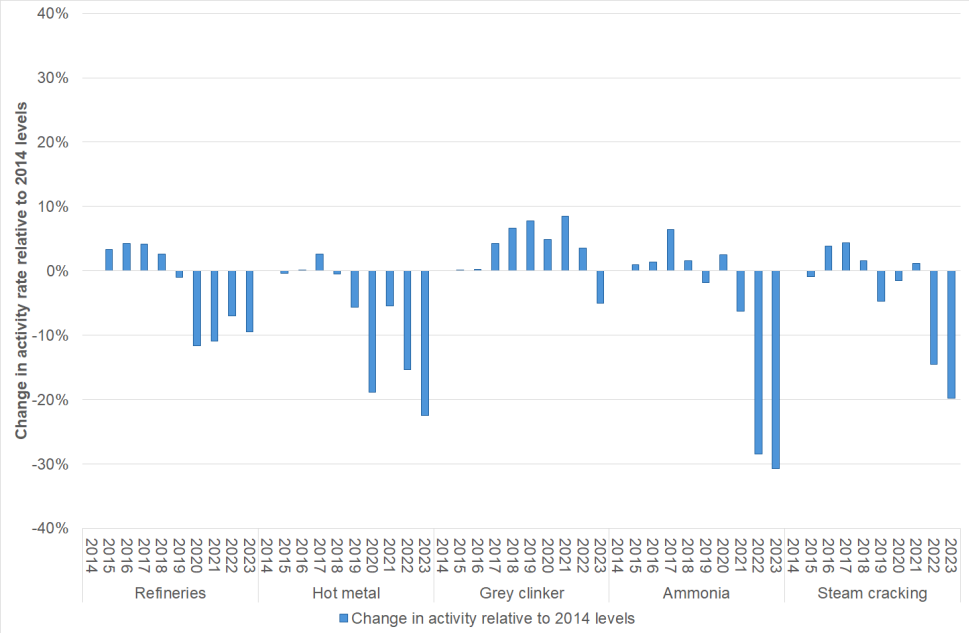
To evaluate the effectiveness of free allocation in preventing carbon leakage, it is necessary to start by outlining the development of the key trends in activity and trade to establish if there is evidence of industrial production re-locating outside of the EU.

To assess changes in activity levels across European industry, the preliminary NIMs dataset provides the most comprehensive and consistent dataset at the sub-installation level and is attributed to the benchmark used by each to apply for free allocation. Figure 21 shows that levels of activity have decreased in the most emission intensive benchmarked products. Given that reforms to free allocation only took effect after 2021, the considerable decline in activity observed in 2020 indicates that other factors beyond carbon pricing have most likely driven this trend (i.e. reduced demand and supply chain issues associated with the COVID-19 pandemic, increase in energy prices (especially natural gas) following the illegal Russian invasion of Ukraine in 2022), as well as the impact in international trade tariff regimes and issues related to overcapacity globally in certain commodities. Indeed, industrial stakeholders confirmed that carbon pricing was not likely to be the main driver of the reduced levels in activity observed in recent years but nevertheless they strongly argued that the increased carbon cost because of free allocation volumes declining, and the EUA price rising have exacerbated an already challenging situation in terms of their international competitiveness.

Given that the NIMs data was only preliminary at the time of the evaluation, it was not possible to estimate statistically whether carbon leakage had occurred based on, for example, econometric approaches. Such an exercise should be conducted when the final NIMs data is available. As an alternative, a more descriptive analysis was undertaken with considerable efforts made to engage with industrial stakeholders in order to better understand the driving factors responsible for the observed changes in activity and trade patterns. It was evident from this descriptive analysis that imports in certain emission intensive goods have increased over the time period (i.e. for example increased imports were observed for cement clinker, urea, unwrought aluminium and hot rolled wide strip and cold rolled steel) and that could, in theory, provide evidence to support claims of carbon leakage via the short term-competitiveness channel. However, it was evident from the stakeholder interviews that the carbon price was not

driving the increase in these imports alone with external factors also influencing the changes observed in trade patterns.

Figure 21: Change in activity levels relative to 2014 levels for selected emission intensive product benchmarks[149]



Source: Preliminary NIMs dataset (2025), Own calculation.

- EQ2: Did a revision of the carbon leakage list (CL list) for 2021-2030 increase the effectiveness of the measure by changing the methodology to a single indicator of carbon leakage?

The purpose of the carbon leakage list is to determine, which sectors and sub-sectors are deemed to be at risk of carbon leakage and are therefore eligible for 100% of the calculated free allocation (i.e. the carbon leakage exposure factor used in the formula for determining free allocation is set at 1).[150] The carbon leakage exposure factor has been set at 1 for sectors and sub-sectors that have been deemed at risk of carbon leakage in both Phase III and IV. Sectors and sub-sectors that were not deemed to be at risk of carbon leakage continued to receive free allowances but were not eligible for the full 100% of the calculated free allocation. During Phase III the carbon leakage exposure factor for sectors and sub-sectors deemed to not be at risk of carbon leakage declined from 0.8 in 2013 to 0.3 by 2020 and the carbon leakage exposure factor has remained constant at 0.3 for Phase IV (2021-25).

The carbon leakage risk status of the sectors and subsectors has been defined based upon a set of rules that have changed over time.

In Phase III a sector or sub-sector was deemed to be at risk of carbon leakage[151] if:

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149 Sub-installations were only included if NIMs data on historic activity level was available for both the 2014-18 and 2019-23 to ensure a consistent dataset across the period.

150 The formula for calculating final free allocation is benchmark * activity level * carbon leakage exposure factor * cross sectoral correction factor.

151 In Phase III of the EU ETS the carbon leakage list was updated several times (i.e. in 2013-14 and 2015-2019 and then extended to 2020).

- Direct and indirect costs induced by the implementation of the directive would increase production cost, calculated as a proportion of the gross value added, by at least 5%; and
- The sector's trade intensity with non-EU countries (imports and exports) was above 10%

A sector or sub-sector was also deemed to be exposed if:

- The sum of the direct and indirect additional costs was at least 30%; or
- The non-EU trade intensity was above 30%.

In Phase IV the carbon leakage list was determined by a single indicator of carbon leakage risk, which is outlined and further explained below:

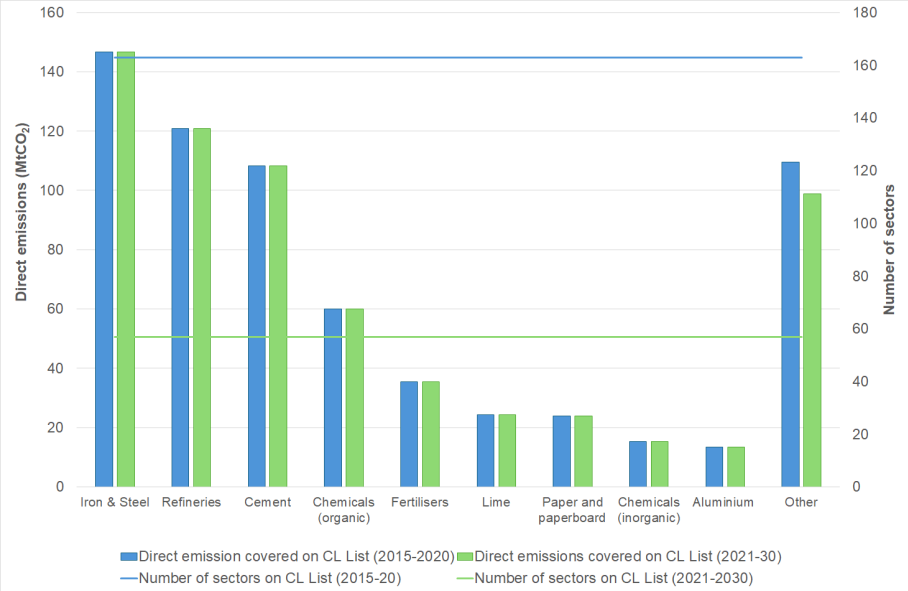
- Carbon leakage indicator = trade intensity * emission intensity
  With
  Trade intensity = (imports + exports) / (imports + turnover)
  Emission intensity = (direct emissions + indirect emissions) / GVA

In terms of the overall impact of the change in methodology, Figure 22 shows that the adoption of a single based indicator reduced the number of sectors at the NACE 4-digit level covered on the 2021-30 carbon leakage list declined by around 65% compared to the 2015-20 carbon leakage list. However, the direct emissions (2014-18 average based on NIMs dataset and aggregated to the NACE 4-digit level) covered only declined by around 2%. This suggests that the changes to the methodology have increased the effectiveness of the measure by removing many sectors that previously only qualified based upon the trade intensity threshold alone but had only a limited impact on the direct emissions covered. The intentional setting of a low threshold for the carbon leakage indicator to determine sectors at significant risk of carbon leakage ensured that free allocation was still better targeted in Phase IV compared to Phase III by ensuring that those sectors with minimal CO_2 costs were no longer eligible for free allocation support.

Although the change to the carbon leakage list in Phase IV has led to a more targeted allocation (in terms of the number of sectors and subsectors deemed at risk of carbon leakage, the European Court of Auditors concluded in their own review of free allocation provision that it could have been better targeted.[152] Indeed, the review criticised the carbon leakage list for not establishing different degrees of carbon leakage risk for the various sectors included in it, instead treating them all equally. Furthermore, lessons learnt from the implementation of the carbon leakage list in Phase III outlined that stakeholders indicated that for the carbon leakage list of 2015-20 the workload for applications was substantial, although at the time it was regarded as proportional to the scale and significance of the task.[153] Given the limited reduction in the emissions not covered under the subsequent update to the carbon leakage list in 2021-30, and the significant resources that remained necessary to update the list, the impact of such changes appears misaligned between outcome (i.e. better targeting of allocation) and administrative effort.

[152] Refer to Emissions Trading System: targeting free allocation of allowances.
[153] Refer to SWD(2019) 22 final, https://edz.bib.uni-mannheim.de/edz/pdf/swd/2019/swd-2019-0022-en.pdf

Figure 22: Comparison of carbon leakage lists for Phase III and IV in terms of their coverage of both direct emissions and the number of sectors[154]



Source: Decision - 2010/2, Decision - 2014/746, Own llustration.

- EQ3: Has free allocation been effectively calculated to prevent the occurrence of carbon leakage?

Since the start of Phase III, free allocation has been calculated based upon product benchmarks and fall-back options with the intention of both better targeting free allocation and to provide stronger incentives for improved performance than under the previous allocation approach (i.e. grandfathering of allowances based on historical emissions). How the benchmark values are set is of critical importance for the effectiveness of free allocation to prevent the occurrence of carbon leakage. If the ex-ante benchmarks are set too high compared to actual performance, then the incentive to improve performance will be reduced, however, alternatively if the ex-ante benchmarks are set too low and beyond technological limits (a concern that was frequently raised during stakeholder engagement with industry), then the effectiveness of free allocation to protect against carbon leakage will be reduced.

Table 10 provides an overview of how the benchmark values were updated for use in the first half of Phase IV (i.e. 2021-25). Given that these values were set ex-ante a useful exercise is to compare how the benchmarks compared with actual developments based upon published information from the European Commission on the setting of the 2021-25 benchmarks. A key takeaway from Table 10 is that 29 out of the 52 benchmarks were updated for the 2021-25 period by applying the maximum limit to the annual update rate used for the calculation. In

[154] The number of sectors refers only to the NACE 4-digit level. If multiple sub-sectors within a NACE 4-digit code are included at a higher level of disaggregation within the carbon leakage lists, they are only counted once. For example, 63 sectors and sub-sectors were on the 2021-30 carbon leakage list, but this included several sub-sectors with the same NACE 4-digit code. Given that the NIMs data only matches installations to a 4-digit NACE code it also means that the direct emissions covered in the calculation may be slightly over-estimated when only certain sub-sectors within a NACE 4-digit code are deemed at risk of carbon leakage.

some cases, the difference between the annual update rate calculated[155] and the annual update rate applied[156] was considerably higher. This means that in practice these benchmarks could have been set more ambitiously (i.e. the update of these benchmarks for 2021-25 were not based on the average of the 10% best performers) than they were if the actual rate of improvement was applied rather than a maximum limit being applied. As a consequence, this may have resulted in the installations covered by these benchmarks receiving more allowances than if actual update rates of improvement were applied and this may have reduced the incentive for driving emission reductions.

Table 10: Comparison of benchmark values set in Phase III and IV of the EU ETS

BM Description	BM Unit	BM (2013-20)	2016/17 AVG of the 10% most efficient installations	Annual update rate calculated	Annual update rate applied	Total update from Phase 3	BM (2021-25)
Refinery products	t CO_2e/CWT	0.0295	0.0255	-1.5%	-1.5%	-23%	0.0228
Coke	t CO_2e/t	0.286	0.144	-5.5%	-1.6%	-24%	0.217
Sintered ore	t CO_2e/t	0.171	0.163	-0.5%	-0.5%	-8%	0.157
Hot metal*	t CO_2e/t	1.328	1.331	0.02%	-0.2%	-3%	1.288
EAF carbon steel	t CO_2e/t	0.283	0.209	-2.9%	-1.6%	-24%	0.215
EAF high alloy steel	t CO_2e/t	0.352	0.266	-2.7%	-1.6%	-24%	0.268
Iron casting	t CO_2e/t	0.325	0.299	-0.9%	-0.9%	-13%	0.282
Pre-bake anode	t CO_2e/t	0.324	0.317	-0.3%	-0.3%	-4%	0.312
[Primary] Aluminium	t CO_2e/t	1.514	1.484	-0.2%	-0.2%	-3%	1.464
Grey cement clinker	t CO_2e/t	0.766	0.722	-0.6%	-0.6%	-10%	0.693

[155] Based on performance data for the years 2007 and 2008, annual reduction rates were determined for each benchmark for the 9-year period from 2007/2008 to 2016/2017.

[156] In accordance with Article 10a(2) of Directive 2003/87/EC, the applied reduction over the 15-year period should not be lower than 3% and not be higher than 24%.

White cement clinker	t CO_2e/t	0.987	0.973	-0.2%	-0.2%	-3%	0.957
Lime	t CO_2e/t	0.954	0.746	-2.4%	-1.6%	-24%	0.725
Dolime	t CO_2e/t	1.072	0.881	-2.0%	-1.6%	-24%	0.815
Sintered dolime	t CO_2e/t	1.449	1.441	-0.1%	-0.2%	-3%	1.406
Float glass	t CO_2e/t	0.453	0.421	-0.8%	-0.8%	-12%	0.399
Bottles & jars (colourless)	t CO_2e/t	0.382	0.323	-1.7%	-1.6%	-24%	0.290
Bottles & jars (coloured)	t CO_2e/t	0.306	0.265	-1.5%	-1.5%	-23%	0.237
Continuous filament glass fibre products	t CO_2e/t	0.406	0.290	-3.2%	-1.6%	-24%	0.309
Facing bricks	t CO_2e/t	0.139	0.094	-3.6%	-1.6%	-24%	0.106
Pavers	t CO_2e/t	0.192	0.140	-3.0%	-1.6%	-24%	0.146
Roof tiles	t CO_2e/t	0.144	0.130	-1.1%	-1.1%	-17%	0.120
Spray dried powder	t CO_2e/t	0.076	0.050	-3.7%	-1.6%	-24%	0.058
Mineral wool	t CO_2e/t	0.682	0.595	-1.4%	-1.4%	-21%	0.536
Plaster	t CO_2e/t	0.048	0.048	-0.0%	-0.2%	-3%	0.047
Dried secondary gypsum	t CO_2e/t	0.017	0.008	-6.1%	-1.6%	-24%	0.013
Plasterboard	t CO_2e/t	0.131	0.119	-1.1%	-1.1%	-16%	0.110
Short fibre kraft pulp	t CO_2e/Adt	0.120	0.000	-11.1%	-1.6%	-24%	0.091

Long fibre kraft pulp	t CO_2e/Adt	0.060	0.001	-11.0%	-1.6%	-24%	0.046
Sulphite pulp	t CO_2e/Adt	0.020	0.000	-11.1%	-1.6%	-24%	0.015
Recovered paper pulp	t CO_2e/Adt	0.039	0.000	-11.1%	-1.6%	-24%	0.030
Newsprint	t CO_2e/Adt	0.298	0.007	-10.9%	-1.6%	-24%	0.226
Uncoated fine paper	t CO_2e/Adt	0.318	0.011	-10.7%	-1.6%	-24%	0.242
Coated fine paper	t CO_2e/Adt	0.318	0.043	-9.6%	-1.6%	-24%	0.242
Tissue	t CO_2e/t	0.334	0.139	-6.5%	-1.6%	-24%	0.254
Testliner and fluting	t CO_2e/Adt	0.248	0.071	-7.9%	-1.6%	-24%	0.188
Uncoated carton board	t CO_2e/Adt	0.237	0.009	-10.7%	-1.6%	-24%	0.180
Coated carton board	t CO_2e/Adt	0.273	0.011	-10.7%	-1.6%	-24%	0.207
Carbon black	t CO_2e/t	1.954	1.141	-4.6%	-1.6%	-24%	1.485
Nitric acid	t CO_2e/t	0.302	0.038	-9.7%	-1.6%	-24%	0.230
Adipic acid	t CO_2e/t	2.79	0.320	-9.8%	-1.6%	-24%	2.120
Ammonia	t CO_2e/t	1.619	1.604	-0.11%	-0.2%	-3%	1.570
Steam cracking	t CO_2e/t	0.702	0.693	-0.15%	-0.2%	-3%	0.681
Aromatics*	t CO_2e/CWT	0.0295	0.0072	-8.4%	-1.5%	23%	0.0228
Styrene	t CO_2e/t	0.527	0.419	-2.3%	-1.6%	-24%	0.401
Phenol/ acetone	t CO_2e/t	0.266	0.244	-0.9%	-0.9%	-14%	0.230
Ethylene oxide &	t CO_2e/t	0.512	0.314	-4.3%	-1.6%	-24%	0.389

ethylene glycols							
Vinyl chloride monomer	t CO_2e/t	0.204	0.171	-1.8%	-1.6%	-24%	0.155
S-PVC	t CO_2e/t	0.085	0.073	-1.5%	-1.5%	-23%	0.066
E-PVC	t CO_2e/t	0.238	0.103	-6.3%	-1.6%	-24%	0.181
Hydrogen*	t CO_2e/t	8.85	4.09	-6.0%	-1.5%	-23%	6.84
Synthesis gas*	t CO_2e/t	0.242	0.009	-10.7%	-1.5%	-23%	0.187
Soda ash	t CO_2e/t	0.843	0.789	-0.7%	-0.7%	-11%	0.753
Heat benchmark	t CO_2e/TJ	62.3	1.6	-10.8%	-1.6%	-24%	47.3
Fuel benchmark	t CO_2e/TJ	56.1	34.3	-4.3%	-1.6%	-24%	42.6

Note: Pursuant to Article 10a(2) of Directive 2003/87/EC, specific provisions apply for the update of the benchmark values for aromatics, hydrogen, syngas, which are adjusted by the same percentage as the refineries benchmark and also for the hot metal benchmark, which is updated with an annual reduction rate of 0.2%.

Source: policy_ets_allowances_bm_curve_factsheets_en.pdf

Figure 23 provides a summary of how selected product benchmark values that were applied in Phase III (2013-20) and Phase IV (2021-25) compared with estimates for the 2016/17 and 2021/22 average specific emissions respectively of all sub-installations covered.[157] The provisional results show that the selected benchmarks for Phase IV (2021-25) are in many cases lower than the specific average emissions for 2021/22 and this indicates that the benchmarks have been set to incentivise further improvements in performance over Phase IV. In many cases, the distance between the product benchmark values and specific average emissions were higher in Phase IV than in Phase III.[158]

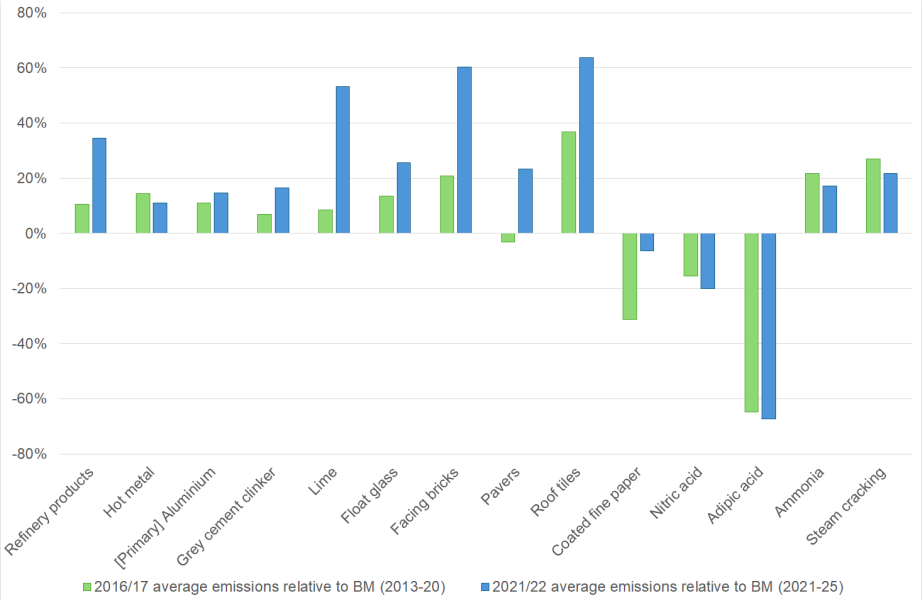
Evaluating the effectiveness of how the updated benchmark values were calculated will ultimately depend upon whether the level of performance required is technically feasible. A concern raised frequently by industrial associations during the stakeholder interviews was in

[157] Only preliminary information from NIMs 2019-23 dataset was available at the time of writing the evaluation and therefore the results are provisional and should be updated following the finalisation of the NIMs dataset for 2019-23.

[158] The Phase III product benchmark values were compared with average 2016/17 specific emissions data provided in a Commission publication (refer to DG CLIMA, 2021. "Update benchmark values for the years 2021-2025 of phase 4 of the EU ETS", https://climate.ec.europa.eu/system/files/2021). Phase IV product benchmark values for 2021-25 were also taken from policy_ets_allowances_bm_curve_factsheets_en.pdf and were then compared with average specific emissions for 2021/22 that were provisionally estimated based upon preliminary NIMs data for 2019-23 for all the sub-installations covered by a product benchmark.

relation to the setting of benchmark values that go beyond what is achievable. The main issue that emerged was to do with the extrapolation of the benchmark values based on annual rates of improvements with the concern raised that such an approach may result in the setting of benchmark values that are simply not possible in practice. Given the abatement potential identified in various industry roadmaps for decarbonisation pathways up until 2050, these technical limits are unlikely to be reached based on the extrapolated values used for the 2021-25 benchmark values, but concerns have been raised more for the viability of future benchmark setting.

Figure 23: Comparison of the average specific emissions in relation to the benchmark for selected products in Phase III and IV



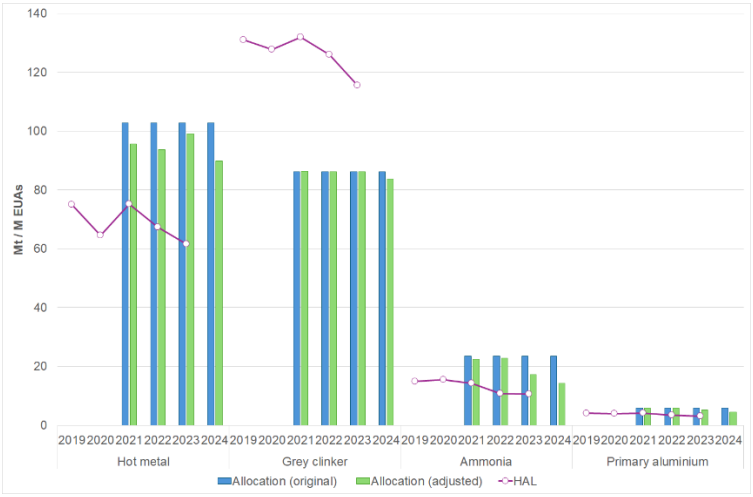
Source: policy_ets_allowances_bm_curve_factsheets_en.pdf, own calculation based upon preliminary NIMs dataset 2019-23

During the interview process, further views were put forward regarding the effectiveness of the setting of the benchmark values.

- Eurometaux criticised the fact that fallback benchmarks group all sectors together under one fallback benchmark value for fuel and heat, regardless of the differences in technologies that can be used in the sectors covered. This leads to inaccurate values, and today, the heat and fuel fallback benchmarks do not adequately reflect the reality of some of the sectors that rely on these benchmarks for the allocation of free allowances to their installations. These fallback benchmarks are currently based on the abatement potential of sectors that can widely use biomass to reduce their emissions. However, some of the sectors covered, such as copper and other non-ferrous metals, cannot rely on biomass to reduce emissions. This is because (1) the use of biomass is not suitable for production processes in every sector, especially those processes that require high-temperature heat, and (2) the supply of biomass is inherently constrained, and not equally available in every Member State.
- EULA also suggested limitations with the current application of the fall-back options expressing how the current benchmarking approach lacks flexibility to consider the issue of process emissions that cannot easily be mitigated without technologies such as CCS that have not so far been economically viable based on the existing carbon price.

In addition to the setting of more ambitious benchmarks in Phase IV, reforms were made to better align free allocation with actual levels of production. Figure 24 shows for selected product benchmarks a simplification for illustrative purposes of the adjustment to free allocation to better align with levels of production over Phase IV. Preliminary NIMs data for 2019-23 on activity levels were used to ascertain at the sub-installation level whether an increase or decrease above or below the 15% threshold had occurred. The original allocation of free allowances was then compared to the adjusted volume of free allowances that consider changes from the previous two-year rolling average[159]. The outcome of this exercise demonstrates how the effectiveness of free allocation has been improved by this better alignment with actual levels of production. Activity levels have declined and rebounded in most industrial sectors after the COVID-19 pandemic and were then further impacted by the energy price crisis triggered by the illegal Russian invasion of Ukraine. The adjustment to allocation because of these externalities further improved the resilience of the EU ETS and ensured that free allocation was better targeted in Phase IV compared to Phase III.

Figure 24: Estimation of the impact of dynamic allocation on the provision of free allocation to selected benchmarks in Phase IV



Source: Own calculation based upon preliminary NIMs dataset 2019-23

Evidence of actual adjustments in response to changes in activity levels beyond the simplified quantitative exercise presented above have been reported by competent authorities. For example, the competent authority in Germany (i.e. DEHSt) reported that levels of free

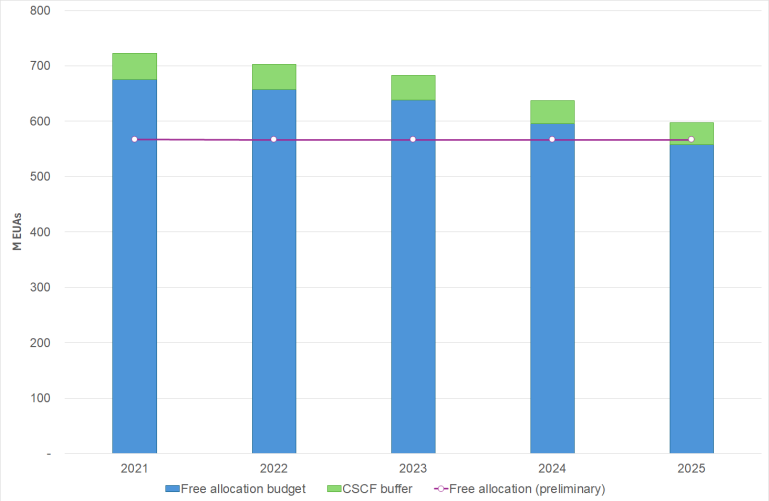
[159] Article 5 of Regulation (EU) 2019/1842 outlines the conditions for adjusting allocation to reflect changes in activity levels. The calculation is a simplification as for each year the allocation is adjusted if the two-year rolling average of the activity level of a sub-installation is 15 % higher or lower than the historical activity level (i.e. 2014-18 average) used to set the original free allocation. The preliminary NIMs dataset for 2019-23 is used to compare the activity level data for the sub-installations with their average historical activity level for 2014-18, which is matched to each sub-installation from the NIMs dataset for 2014-18. In circumstances where the 15% threshold is exceeded, free allocation is recalculated for a sub-installation based upon the previous rolling two-year average activity level and this is multiplied by the corresponding benchmark, carbon leakage exposure factor and cross sectoral correction factor. The original and adjusted allocation was then aggregated for all sub-installations covered by a product benchmark to estimate the potential impact of the intervention.

allocation declined across many industrial sectors in 2024 with the declines in activity observed after the energy price shock of 2022 fully reflected in the two-year rolling average.[160]

A consensus emerged from the stakeholder interviews with industrial associations that the better alignment of free allocation with levels of activity change was regarded as a welcome improvement. The main critique of the reform from industry, however, related to the setting of an activity threshold that was often seen as a disincentive for an installation to incrementally increase their production as any change up to 15% would be subject to the full carbon price. Indeed, this point was made repeatedly by industrial stakeholders in the context of their own production process. However, the 15% a threshold level for activity level changes represents a balance between ensuring that the free allocation level reflects the actual production level, with minimising the administrative burden for operators and competent authorities of reporting, verifying and approving adjustments to free allocation based on small changes in activity levels. Furthermore, it can be said that this provision provides industrial installations a buffer of free allocation for a production decrease of less than 15%, as the allocation levels are not adjusted.

As part of the effective implementation of free allocation provision, the cross sectoral correction factor (CSCF) ensures that volumes of free allocation do not exceed the ETS cap. In Phase III it was necessary to apply the CSCF in all years between 2013 and 2020 to reduce free allocation volumes and so a CSCF buffer was introduced at the start of Phase IV to reduce the likelihood of the CSCF needing to be applied. However, Figure 25 illustrates mainly that because of the introduction of more ambitious benchmarks at the start of Phase IV, the resulting reduction in free allocation volumes meant that it was not necessary to apply the CSCF.

Figure 25: Free allocation (preliminary) volumes in 2021-25 compared to the free allocation budget and CSCF buffer



Source: Own calculation based upon NIMs dataset 2019-23[161]

[160] Emissions Situation in EU ETS 1 in 2024 - Stationary Installations, "Aviation and Maritime Transport Subject to Emissions Trading in Germany", https://www.dehst.de/SharedDocs/downloads/EN/publications/2024_VET-Report.pdf?__blob=publicationFile&v=2

[161] Based upon the ETS cap, the free allocation budget for each year is calculated as 43% of the ETS cap and a further 3% of the ETS cap is added each year as a further CSCF buffer. The preliminary free allocation for 2021-25 was taken directly from the total annual provisional values provided in the NIMs database.

- EQ4: Has the indirect cost compensation been an effective measure to support the sectors under EU ETS to prevent occurrence of carbon leakage?

Effectiveness in compensating installations at risk of carbon leakage

Under the EU ETS, firms incur two types of carbon costs: direct costs from purchasing allowances for their emissions, and indirect costs passed through in electricity prices, as power generators must also cover their emissions. These indirect costs can be significant, especially for energy-intensive sectors. To address the risk of carbon leakage brought by indirect costs, the ETS Directive encourages Member States to compensate selected sectors through State aid. This compensation is optional at the MS level, creating heterogeneity in application and raising questions about its efficiency.

Governance of indirect carbon cost compensation is split between the ETS Directive and the relevant State aid guidelines[162]. The ETS Directive (Article 10a(6)) provides general guidance to Member States. It encourages them to provide compensation to sectors and subsectors at genuine risk of carbon leakage due to significant indirect costs passed on in electricity prices, in accordance with State aid rules, and outlines that they should seek to use no more than 25% of their auction revenues for this purpose. The Directive also specifies that the aid should be based on benchmarks for indirect emissions per unit of production corresponding to the most efficient available technologies and on the CO_2 emissions of the relevant electricity production mix.

The State aid guidelines themselves identify eligible sectors, benchmarks, emissions factors and conditions for granting the aid. State aid guidelines governing indirect carbon cost (ICC) compensation were first adopted in 2012 for the period 2013-20. New guidelines for the post-2021 period were adopted in 2020 and amended in 2025[163]. Therefore, it is the guidelines, rather than the ETS Directive itself, that define which sectors are at risk of carbon leakage due to indirect carbon cost.

Article 10a(6) was amended in the 2018 amendment of the ETS Directive. The main changes introduced were:

- To introduce a ‘soft’ cap on ICC compensation (Member States shall seek to use no more than 25% of their annual auction revenues).
- To introduce reporting requirements for Member States and a requirement for the Commission to assess ICC compensation in its annual report on the functioning of the European carbon market[164]. Member States are report on the amount of ICC provided per sector and subsector, on why aid exceeds 25% of revenues (if applicable), on electricity prices for industrial consumers, and whether they have considered other measures to lower indirect carbon costs.
- To amend other elements. For example, the invitation to Member States to provide ICC compensation changed from ‘may’ to ‘should’, and the sectors eligible were changed from those ‘determined to be exposed to a significant risk of carbon leakage’ to those ‘exposed to a genuine risk of carbon leakage’ due to indirect costs ‘actually incurred’.

[162] Guidelines on certain State aid measures in the context of the system for greenhouse gas emission allowance trading post-2021 (2020/C 317/04)

[163] These guidelines are communications 2012/C 158/04, 2020/C 317/04 and C/2026/196 respectively.

[164] COM(2024) 538 final

The amount of aid provided depends on the limits set out in the State aid guidelines (where the aid permitted is a function of activity level, carbon price, sectoral efficiency benchmarks and emission intensity of the power sector). It also depends on the preferences of Member States regarding whether to operate a State Aid scheme, how much budget to allocate to it, and which sectors to cover. Total ICC compensation has risen over time, from EUR 0.5bn for costs incurred in 2017, to EUR 1.8bn for costs incurred in 2019, EUR 2.3 bn in 2020, EUR 3.1 bn in 2022 and EUR 5.5 bn in 2023. The increase is mainly due to increases in the EUA price over the same period (which generate both the need for compensation and the resources to fund it). It is also partly due to increases in budget and participation by Member States (though this can vary year-on-year). Reports from Member States include justifications for exceeding 25% of auctioning revenues where applicable. Member States typically attribute this to the level of carbon prices, with some also attributing it to a high historical national share of low-carbon electricity generation compared to their share of electro-intensive industries (i.e. more demand for compensation relative to available auction revenues).

The total payments for indirect costs incurred in 2022 were equivalent to 16% of the 2022 auction revenue collected by 15 Member States. However, five Member States (Austria, Belgium, France, Luxembourg and Romania) provided aid in excess of the recommended 25% limit.[165] This demonstrates that Member States differ in their prioritisation of ICC payments. However, each Member State's share of national ETS auction revenues is not necessarily correlated to the size of its electro-intensive industries.

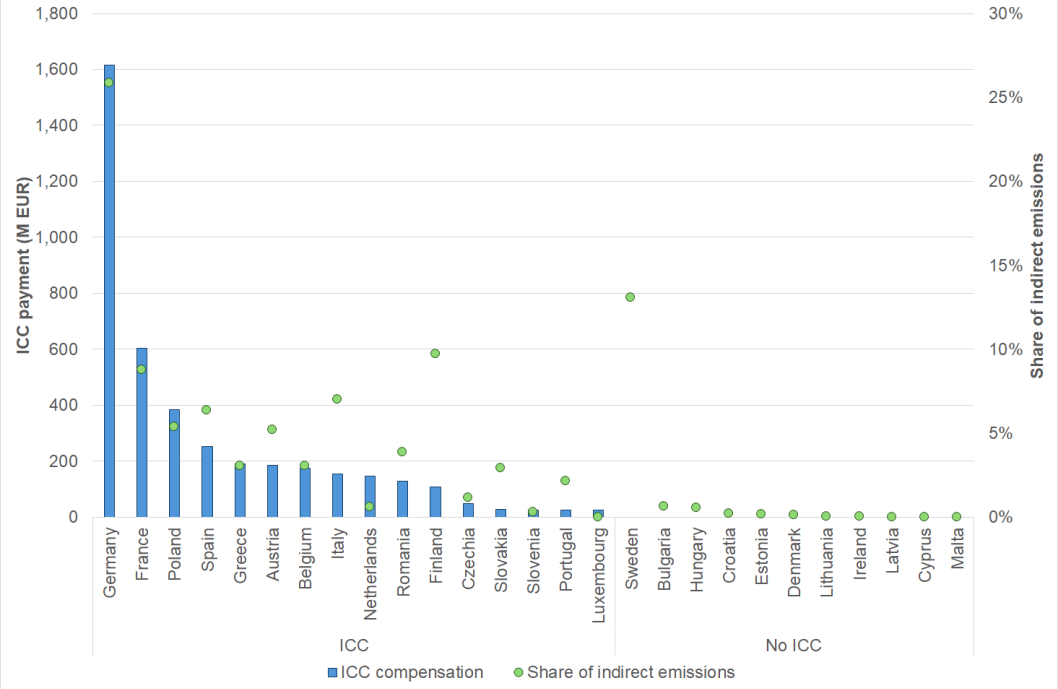
Reports from Member States are used by the Commission to assess ICC payments as part of the annual report on the functioning of the European carbon market. The level of detail possible in this assessment is limited due to differences between Member States in the level of detail and topics covered. This in turn is not surprising, given the low level of precision in the Article 10a(6) reporting provisions. In order to estimate how the potential need for ICC payments are distributed across Member States, Eurostat data on the electricity consumption of each Member State by NACE activity was combined with Prodcom data on sold production to provide a simplified comparison of each Members State's ICC payment relative to its share of EU27 indirect emissions in relevant sectors (a rough metric for their *potential* to provide ICC compensation if they wished).

The outcome of this exercise is illustrated in Figure 26 below. It indicates that Germany provides the most aid and has greatest need, while Italy and Spain provide relatively little compared to their industry size.

While the figure suggests that Finland and Sweden have a substantial need for compensation, this may be misleading. In the case of Sweden, the high share shown in the figure replicates the State aid guidelines, which use a national emission factor to represent. However, the Swedish electricity market is split into four zones, with much of industry represented in Northern zones where electricity is both cheaper and less carbon intensive. In the case of Finland, the exposure of industry to indirect carbon costs may be lower than shown in the figure since a proportion of Finnish industries tend to generate their own electricity, so will not be exposed to indirect carbon cost passed on through marginal electricity pricing to the same extent as firms reliant on traded electricity.

[165] REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL on the functioning of the European carbon market in 2023, SWD(2024) 264 final

Figure 26: Indirect cost compensation (2021-23 average) of each Member State compared to their share of the total EU indirect emissions (2021-23 average) that were eligible for ICC payments



Note: No information on PRODVAL for NACE code 19.20 (i.e. refined petroleum products) so excluded from the graph and calculation of indirect emissions but ICC payments to sector are represented by the blue bar.

Source: Eurostat (2025), Own calculation.

Effectiveness of reporting and conditionality framework in guiding expenditure by beneficiaries

Both the ETS Directive and State aid guidelines include reporting requirements for Member States. These are summarised in Table 11 below. As the table shows, the reporting requirement under the ETS Directive is more qualitative, open to Member State interpretation and intended for a public audience. On the other hand, the reporting requirements from the State aid guidelines are more specific.

Table 11: Reporting Requirements for Member States providing State aid for Indirect Carbon Cost Compensation

ETS Directive	State aid guidelines
Article 10a(6) Member States shall make available to the public, in an easily accessible form, within three months of the end of each year: • Total amount of compensation provided per benefitting sector & subsector. • The reasons for exceeding 25% of auction revenues (if applicable).	2020/C 317/04. Point 60 Member States report annually to the Commission using the standard form, including: • name of each beneficiary & aided installation. • sector(s) in which beneficiary is active (NACE-4 code). • year for which aid is granted and year paid.

• Information on electricity prices for large industrial consumers benefitting from ICC compensation. • Whether due consideration has been given to other measures to sustainably lower ICC costs in the medium to long term. Commission • Assessment, in the annual report on the functioning of the European carbon market, of effects of ICC compensation on the internal market. • where appropriate, recommend any measures that may be necessary.	• actual output for each aided installation. • actual electricity consumption for each aided installation (if aid is given using a fallback benchmark). • EUA forward price used to compute aid amount • Aid intensity • National CO_2 emission factor

From 2021 onwards, the State aid guidelines for ICC compensation include the requirement that beneficiaries of the aid take action to improve their environmental performance by either i) implementing recommendations of an energy audit (provided the pay-back time does not exceed three years); ii) covering at least 30% of their electricity consumption from carbon-free sources; or iii) investing at least 50% of the aid amount in projects leading to substantial reductions in the installation's greenhouse gas emissions. Member States are not required to report on how these conditions are implemented, although in several cases documentation of the Member States' implementation rules is publicly available.

Commercial stakeholders were also consulted for this evaluation. Their observations included that due to the functioning of the electricity market based on marginal pricing, indirect costs paid by EU industry in the electricity price are not linked to the actual emissions of the electricity consumption but to the emissions of the marginal electricity producer, which they expect to remain largely fossil-based beyond 2030. While this may be true, the design of the State aid guidelines already takes this into account since their emissions factors are based on CO_2 intensity of electricity produced from fossil fuels in the relevant geographical zone (the long-term implications of this are explore in Annex 12 of the Impact Assessment). The guidelines also provide Member States with the option of instead using an emissions factor based on market-based modelling, though only two Member States currently make use of this.

Stakeholders also pointed out that financial compensation is typically only allowed for 75% of eligible costs and is not implemented (at all or to the full extent) in several Member States, which leaves local industries exposed to indirect costs without protection. Limiting the aid intensity to 75% is an intentional feature of the guidelines, designed to limit negative effects on competition and maintain an incentive to reduce indirect emissions (e.g. by improving energy efficiency).

Stakeholders from sectors that at that point were not eligible for ICC compensation (such as glass and ceramics) stressed how their inclusion would help their sectors to switch to electrified processes. These sectors have since become eligible in the 2025 amendment to the State aid guidelines.

8.3.4.2 Efficiency

The efficiency of free allocation as a measure for reducing the risk of carbon leakage is evaluated on the basis of the following questions:

- EQ1: Are the current carbon leakage provisions only applied to those (sub-)sectors where it is necessary?

Based upon the quantitative assessment undertaken in the previous section on effectiveness, the change to a single metric for determining the carbon leakage list in Phase IV resulted in free allocation becoming more targeted in comparison to Phase III. The removal of many sectors and sub-sectors from the carbon leakage list that previously only qualified for free allocation on the basis of trade intensity alone represents an improvement in overall effectiveness.

- EQ2: Is the increased amount of free allocation due to the carbon leakage provisions cost-efficient, in particular with a view to reduced auctioning revenues for MS? Is there evidence for significant cases of windfall profits, which would prove inefficiency in this regard?

Evidence of windfall profits

The EU ETS aims to internalise the cost of carbon into economic decisions, particularly by creating a price signal that influences both producers and consumers. A key component of this mechanism is cost-pass-through, which occurs when firms factor the carbon price into product prices, even if they receive emission allowances for free. This is grounded in standard economic theory: if a company uses a free allowance to comply with emission rules, it gives up the opportunity to sell it, meaning the opportunity cost of that allowance is equal to its market value. Firms seeking to recover all costs, including opportunity costs, are thus incentivised to pass those costs to consumers through higher prices.

It should be noted that cost-pass through itself is not a flaw, but rather a design feature of the EU ETS. By raising the prices of carbon-intensive goods, the ETS aims to steer consumption toward cleaner alternatives. This makes the ETS more efficient by ensuring that the carbon costs are reflected throughout the economy. The potential issue, however, arises when firms receive allowances for free and still raise prices. This results in altered consumer behaviour, but also in windfall profits.

Windfall profits occur when companies can pass through carbon cost and consequentially raise prices based on the market value of emission allowances they receive for free. The CE Delft report[166] quantifies windfall profits by estimating the additional profits companies earned through the EU ETS, primarily as a result of receiving free emission allowances. The core component of the methodology focused on calculating the value of cost-pass through for carbon allowances. These profits were calculated by multiplying verified emissions by the estimated cost pass through rate and the annual EUA price. To reflect real-world conditions, the analysis also adjusts for potential loss in market share due to higher prices, by comparing firm-level profits under a cost pass through scenario to a counterfactual scenario with no pass-through. Additional sources of windfall profits identified by the CE Delft report include profits from the overallocation of allowances and the use of cheaper international offsets for compliance, which, however, is no longer allowed in the EU ETS. Cost pass through was identified to be the largest driver of windfall profits, with an estimated EUR 26-46 billion between 2008 and 2019, after adjusting for market share losses. The study shows that in almost all sectors, the additional profits from cost pass through largely outweighed any loss in profits due to reduced market share. The iron and steel, refineries and cement sectors accrued respectively up to 16

[166] CE Delft, 2021. "Additional profits of sectors and firms from the EU ETS 2008-2019", Delft

billion EUR, 12 billion EUR, and 7 billion EUR of windfall profits from carbon cost pass through.[167]

1. Evidence on cost pass-through of EU ETS carbon costs in industry is very limited, especially when compared to the extensive literature for the power sector. The only systematic, multi-sector econometric evidence available remains the ex-post study by Cludius et al. (2020)[168], which is now relatively dated and covers mainly Phases II and III of the EU ETS (roughly 2008–2014). Using product-level price data for more than 50 product–country combinations across six industrial sectors (cement, iron and steel, refineries, fertilisers, petrochemicals and glass), the study applies econometric cost-price models to identify whether changes in EUA prices are reflected in product prices. The analysis finds statistically significant evidence of carbon cost pass-through in around 60% of the cases examined, with results most robust for cement, iron and steel, and refineries. Indicative pass-through rates are estimated to range from about 20-40% for bulk cement products, rising to 90-100% for Portland cement, 55-85% for most steel products, and 80-100% for refinery products, while results for fertilisers, petrochemicals and glass are more mixed and less robust due to data and modelling limitations. Importantly, the authors stress that these rates are indicative rather than precise, reflecting substantial heterogeneity across products and countries and the inherent difficulty of estimating pass-through in industrial markets with opaque pricing, limited high-frequency data and complex market structures.

2. For the power sector, a small number of empirical studies provide more systematic evidence, albeit with important limitations. In particular, Bai and Okullo (2023)[169] analyse carbon cost pass-through in electricity markets using futures price data for seven European power markets (Germany, France, Italy, the Netherlands, Belgium, the UK and Nord Pool) over EU ETS Phases II and III, finding that allowance costs are fully or more-than-fully passed through to wholesale electricity prices, consistent with marginal cost pricing and fuel-switching under competitive power market conditions. More recent evidence for Italy[170] alone suggests that pass-through in electricity markets during Phases III and IV is positive but incomplete, with average pass-through rates of around 30% and substantial regional heterogeneity across bidding zones, reflecting differences in generation mix and market structure. While these studies support the conclusion that carbon costs are at least partially reflected in electricity prices, their applicability is constrained by data coverage (futures or zone-specific prices), sectoral focus (power only), and geography, and none provides EU-wide, multi-country evidence for Phase IV as a whole.

These findings have significant implications for the efficiency of the ETS. Although cost pass through helps internalise the cost of carbon, windfall profits arising from free allocation do not necessarily contribute to decarbonisation. Free allocation is considered to be the primary cause

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[167] However, the cost pass through rates applied in the CE Delft study were based on a range of literature sources that are not accepted by industrial sectors who argued strongly during the stakeholder consultation that their ability to pass through costs were very limited.

[168] Johanna Cludius, Sander de Bruyn, Katja Schumacher, Robert Vergeer, 2021. "Ex-post investigation of cost pass-through in the EU ETS - an analysis for six industry sectors", https://doi.org/10.1016/j.eneco.2020.104883.

[169] Yiyi Bai, Samuel J. Okullo, 2023. "Drivers and pass-through of the EU ETS price: Evidence from the power sector", Energy Economics, https://doi.org/10.1016/j.eneco.2023.106698.

[170] Pierdomenico Duttilo, Francesco Lisi, 2026. "Carbon cost pass-through rate in power system: evidence from Italy under the EU ETS", https://arxiv.org/pdf/2604.03076

of windfall profits under the ETS. As the system matures, a reduction in free allowances, combined with increased auctioning and the full implementation of the EU CBAM is expected to reduce these undue rents and improve the system's effectiveness, while still shielding industries from international competition.

The extent to which carbon costs could be passed through was, however, strongly contested by industry during interviews with stakeholders from all sectors.

- *Eurofer* outlined that, in their view, the carbon cost cannot be passed through to the consumer with the fundamental reason being that there is simply too much competition from imports entering the domestic market for steel products in Europe. On average, imports currently account for around 25% of the domestic consumption of finished steel products in the EU. As a consequence, there is a constant downward pressure on prices to remain competitive, and this limits the ability of EU producers to pass through the carbon cost. It was, however, acknowledged that some markets may in the future be more open for accepting green products, but this is not currently the case. The pressure faced by EU firms in the steel sector is reflected by the overall negative financial results in recent years with the exception of the post COVID-19 recovery that benefited most industrial sectors.
- *Eurometaux* further argued that the sector operates on thin margins in global markets where carbon costs cannot be passed on, and where competitors (e.g. China) do not face equivalent rules and carbon pricing. As a price-taker industry, these additional carbon costs cannot be passed on to customers without losing significant market share.
- *Fertilisers Europe* stated that as European producers are often the marginal producer, this means that the additional unilateral carbon cost element could act as the trigger that results in a loss in market share and exacerbates issues with the other main cost element of production i.e. the relatively high natural gas prices in Europe. It is not possible, in the view of Fertilisers Europe, to pass through the carbon cost.
- *Glass for Europe* argue that the carbon price is a unilateral cost and there remains a fear within the flat glass industry that a continuation of the recent rising trend in EUA prices will only exacerbate the problems that the industry faces in a very volatile trading environment. In this context, products with low margins means any extra cost will be a great source of concern.
- *CEPI* emphasise that their members operate on small margins and continue to compete at a global level but warn that the risk of carbon leakage is real and may only be definitely proven when it is too late and industry has relocated elsewhere.
- *CEFIC* underlined that the carbon cost is one of the main elements impacting the business operations in Europe due to its role in the marginal price of electricity.

Distortion of the carbon price signal

One of the primary objectives of the EU ETS is to reduce GHG emissions by putting a price on carbon and using market forces to drive cost-effective decarbonisation. The carbon price, set by the market through the trading of emissions allowances, is intended to signal to firms that pollution has a cost and that investing in cleaner technologies is economically desirable. In theory, this price signal should guide both operational and investment decisions, encouraging emitters to reduce emissions and innovate toward low-carbon alternatives.

However, in its earlier phases, the EU ETS failed to deliver on these expectations due to significant design flaws. During Phase I and II, the system was undermined by over-allocation of free allowances, the use of the National Allocation Plan that lacked coordination, and a lack

of robust demand for allowances. This resulted in a persistently low and volatile carbon price, at times close to zero. With allowances in oversupply and compliance costs minimal, many firms opted to trade permits rather than invest in cleaner technologies. This blunted the price signal and significantly weakened the incentive for innovation. The opportunity to reduce emissions for profit by using fewer allowances and selling the surplus, was present in theory but undermined in practice by weak market conditions and allocation choices.

Recognising these shortcomings, the EU gradually improved the ETS. From Phase III onwards, substantial reforms were introduced to improve market functioning and restore the credibility of the price signal. Notably, the system moved from decentralised allocation to a centralised EU-wide cap, tightened the supply of allowances, introduced benchmarking for free allocation based on the most efficient installations, and made auctioning the default method for allocating allowances.

Another persistent challenge is the continued use of free allocation, particularly in sectors deemed at risk of carbon leakage. While free allocation helps shield European industry from competitiveness impacts, it also distorts the carbon price signal by reducing the effective carbon cost faced by firms.[171][172] Sectors with higher pass-through capacity firms may pass the notional cost of allowances to consumers while still receiving them for free, leading to windfall profits rather than actual emissions reductions or innovation. In contrast, sectors with lower pass-through ability more likely to show stronger innovation responses to the ETS price signal[173].

These distortions have important implications for ETS efficiency. The system's design improvements have made the ETS more effective, but empirical evidence remains mixed, particularly for Phase III and IV. The scarcity of research focused on these later phases limits our understanding of whether reforms have fully addressed past distortions and sufficiently improved the incentive for innovation.[174][175]

- EQ3: What are the impacts of the allocation rules and carbon leakage provisions on the administrative costs? Can improvements be observed by the harmonised rules compared to previous phases?

A 2025 survey conducted for this evaluation aimed at EU stationary installations operators provides insights on the administrative costs of allocation rules, with responses from 278 installations. Respondents were asked to provide an estimate of the hours per person required to fulfil specific activities related to free allocation rules, including time spent on data reporting, learning rules, purchasing equipment, etc.

Table 12 summarises the estimated average administrative cost by industry[176], considering the data on hours per person required for the activities and the level of emissions indicated by operators.

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171 Nguyen, P.-V. and Pellerin-Carlin, T. (2021)

172 Scotti, F., Flori, A., Crescenzi, R., & Pammolli, F. (2025).

173 Ibid

174 Rahel Mandaroux, Kai Schindelhauer, Houdou Basse Mama, 2023. "How to reinforce the effectiveness of the EU emissions trading system in stimulating low-carbon technological change? Taking stock and future directions", https://doi.org/10.1016/j.enpol.2023.113697.

175 Sitarz, J., Pahle, M., Osorio, S. *et al.*, 2024. "EU carbon prices signal high policy credibility and farsighted actors". *Nat Energy* 9, 691–702, https://doi.org/10.1038/s41560-024-01505-x

176 Data on labour costs per hours by industry and EU country was extracted from Eurostat.

Our estimates indicate that, on average, the administrative cost per tonne of emissions across industry and country is 0.98 EUR. Considering an average EU ETS price in 2025 of 68.77 EUR,[177] the administrative cost is approximately 1.43% of the carbon cost.

Table 12: Average administrator costs per tonne of CO_2 emissions

Industrial activity	Average administrative cost per tonne of CO_2-eq
Ammonia production	N/A
Bulk organic chemicals production	EUR 0.36
Carbon black production	EUR 0.09
Cement clinker production	N/A
Ceramics manufacture	EUR 0.42
Combustion of fuels	EUR 1.92
Drying or calcination of gypsum	N/A
Ferrous metals production	EUR 0.17
Glass manufacture	EUR 0.13
Hydrogen production	N/A
Iron & steel production	EUR 0.2
Lime, dolomite, or magnesite calcination	EUR 0.18
Metal ore production	N/A
Mineral wool manufacture	EUR 0.42
Nitric acid production	N/A
Non-ferrous metals production or processing	N/A
Paper production	EUR 0.50
Primary aluminium production	EUR 0.04
Pulp production	EUR 0.58

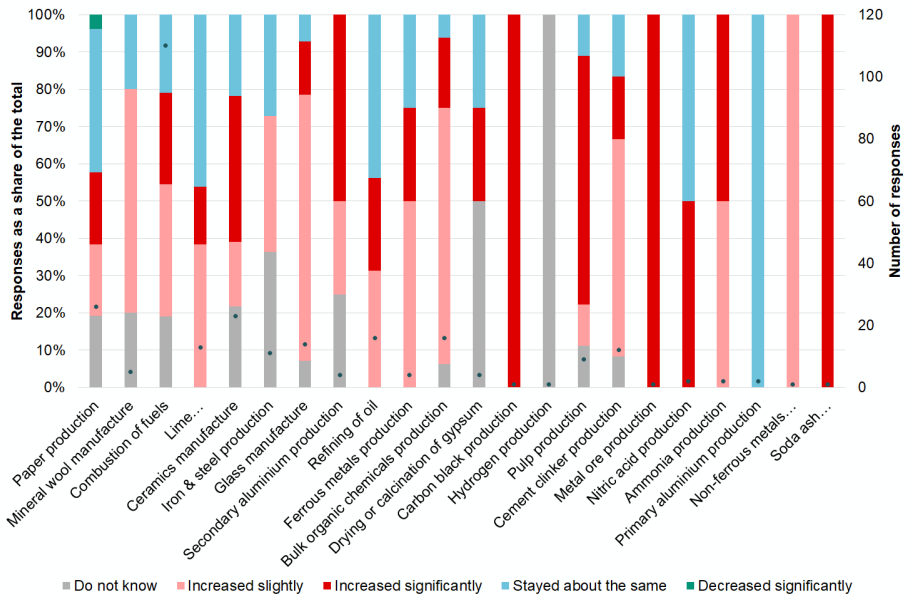
[177] Data on EU ETS price is available on ICAP Allowance Price Explorer

Refining of oil	EUR 0.07
Secondary aluminium production	EUR 0.04
Soda ash and sodium bicarbonate production	EUR 0.03
Total	EUR 0.98

Source: Own calculation following the Standard Cost Model using survey data collected from ETS operators for the purpose of this evaluation.

The survey inquired on the administrative costs for applying free allocation rules in Phase IV compared to Phase III. Across sectors, the majority of respondents reported either *slight increase* or a *significant increase* in costs, with very few perceiving a decrease. This trend was consistent across company size, although larger installations (>500 staff) more frequently reported significant increases, while very small operators (<10 staff) were more likely to report "do not know", or only slight increases. Open responses provide context for these answers. Operators pointed to the additional requirements introduced in Phase IV, in particular to the new Activity Level Change rules, expanded monitoring and reporting obligations, and more complex verification procedures. Many respondents highlighted a greater need for external consultants and verifiers, with some reporting fee increases of 15-18%. Inflation, rising staff costs, and a shortage of accredited verifiers further compounds the costs.

Figure 27: Compared to Phase III of the EU ETS, has the administrative cost of applying for free allocation in Phase IV for your company (categorised by industry)



Source: Own calculation following the Standard Cost Model using survey data collected from ETS operators for the purpose of this evaluation

Table 13: Compared to Phase III of the EU ETS, has the administrative cost of applying for free allocation in Phase IV for your company (categorised by company size)

Size	Do not know	Increased slightly	Increased significantly	Stayed about the same	Decreased significantly	Row total
< 10 persons	29%	29%	0%	43%	0%	7
10 - 49 persons	17%	37%	23%	23%	0%	30
50 - 99 persons	25%	13%	28%	34%	0%	32
100 - 199 persons	20%	30%	36%	14%	0%	50
200 - 249 persons	13%	42%	19%	26%	0%	31
250 - 499 persons	19%	45%	18%	18%	0%	62
> 500 persons	3%	40%	27%	29%	2%	63
Do not know	33%	33%	33%	0%	0%	3

Source: Own calculation following the Standard Cost Model using survey data collected from ETS operators for the purpose of this evaluation.

The stakeholders that were interviewed as part of the evaluation were given the opportunity to provide their view on the administrative burden associated with compliance with the EU ETS and specifically with reference to the free allocation application process. Views varied amongst respondents on the proportionality of the administrative burden:

- *Eurofer* discussed that steel is a very large emitter, so the sector has a big responsibility. They believed that the overall administrative burden was proportionate and reflected the relevance of the sector, however recent new administrative requirements related especially to the Activity Level Change reporting feels more disproportionate and especially for installations lower than the value chain with lower emissions such as rolling mills. Given the large number of PRODCOM codes associated with steel these inputs require considerable administrative efforts. Simplification could be improved by improving some rules on free allocation, for instance with fully dynamic free allocation and with simpler rules on conditionality.
- *Cerame-Unie* emphasised that the ceramic industry is composed mainly of SMEs (over 80%) and is the most numerous industrial sector in terms of installations in the ETS system (over 1200) however, they constitute only below 1% of all industrial emissions.

The administrative burden connected with the ETS is extremely high for companies, especially the small emitters and the SMEs, which do not have human or financial resources to hire staff dealing with the administration. Also, the activity changes regulations add up to this burden. With regards to the different types of costs – the question on specific elements of monitoring, reporting, hedging, surrendering must be made to specific companies. For reduction of costs – please see the section on simplification of admin burden.

8.3.4.3 Coherence

At first sight, free allocation appears inconsistent with the core objective of the EU ETS, which is to drive cost-effective emissions reductions through a market-based price on carbon. By granting allowances to certain industries at no cost, it shields them - partially or fully - from the carbon price signal that should incentivise decarbonisation and investment in low-carbon technologies. Yet free allocation has been justified as a necessary measure to prevent carbon leakage: without it, there would be a risk not of decarbonisation, but of deindustrialisation, with production and emissions simply relocating outside the EU, harming both growth and employment. In this sense, free allocation can be seen as coherent with the ETS's long-term aim, as it provides a transitional pathway. It has allowed energy-intensive industries to remain competitive while being gradually exposed to the carbon price, giving them time to internalise costs, adjust investment strategies, and prepare for deeper decarbonisation. Ultimately, free allocation is only effective if accompanied by the right enabling conditions, such as access to affordable low-carbon energy, that ensure domestic production can continue while the cost of mitigation technologies falls and the ETS price signal strengthens.

Feedback from the Open Public Consultation highlighted diverging views on the coherence of free allocation: while critics argued it undermines the EU ETS and the 'polluter pays' principle, industry respondents saw it as essential for preventing carbon leakage and maintaining competitiveness. Many noted that the CBAM could enhance coherence if it enables a phase-out of free allocation without harming industry.

8.3.4.4 EU added value

In addition to the findings in Section 4.2.1. on the EU added value of the EU ETS as a whole, some further considerations should be made concerning the EU added value in the area of carbon leakage and free allocation.

Harmonisation at the EU level ensures that there is no carbon price difference within the EU, which affects the domestic market and prevents internal carbon leakage. If the ETS had been established at the Member States level instead of the EU level, differences in carbon prices would easily move production to the country(ies) within the EU with the lowest carbon prices. Moreover, harmonisation of free allocation rules across Member States and, more specifically, of product benchmarks since Phase III of the EU ETS ensures that firms across the EU are treated equally to prevent any potential market distortions.

8.3.4.5 Relevance

The relevance of free allocation as a measure for reducing the risk of carbon leakage is evaluated on the basis of the following questions:

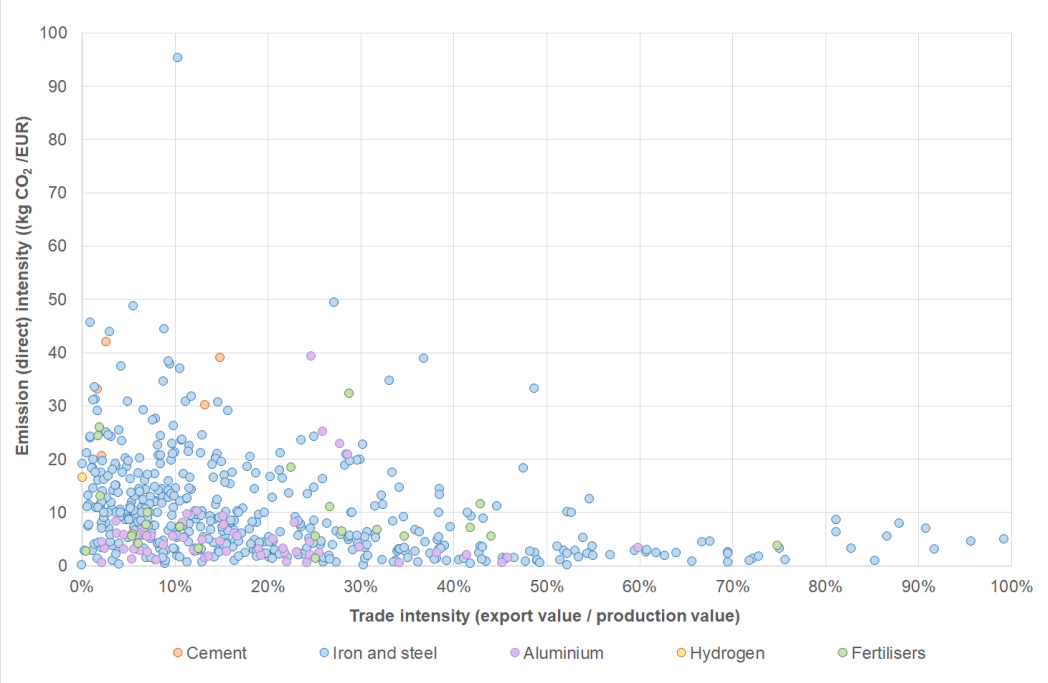
- EQ1: To what extent is the concept of carbon leakage valid in the context of the EU ETS?

As long as certain industrial sectors remain high emitters of CO_2 and assuming that comparable levels of carbon pricing do not exist in key trading partners, then carbon leakage will remain a valid concern in the context of the EU ETS. The following two subsections will briefly examine both the emission intensity of European industrial production and carbon pricing internationally to evaluate the relevance of carbon leakage as a valid concept in the context of the EU ETS.

Sectors currently deemed exposed to a carbon leakage risk

Figure 28 shows a comparison of export intensity[178] and emission intensity[179] values for a selection of CN codes from certain emission intensive sectors covered under the EU ETS that are also currently within the scope of the CBAM (i.e. iron and steel, cement, aluminium, fertilisers and hydrogen).

Figure 28: Comparison of export intensity with emission intensity based on a 2022-24 average for CN codes covered under the CBAM



Source: Own illustration based upon information from PRODCOM, COMEXT and values from JRC (refer to JRC Publications Repository - Greenhouse gas emission intensities of the steel, fertilisers, aluminium and cement industries in the EU and its main trading partners)

For the more emission intensive products that are more frequently traded, carbon leakage remains a valid concept in the context of the EU ETS with the additional cost of compliance potentially undermining levels of international competitiveness. Of course, competitiveness is the result of many factors beyond carbon pricing but the fact that trade intensive products remain currently emission intensive means that the concept of carbon leakage remains relevant and needs to be carefully evaluated.

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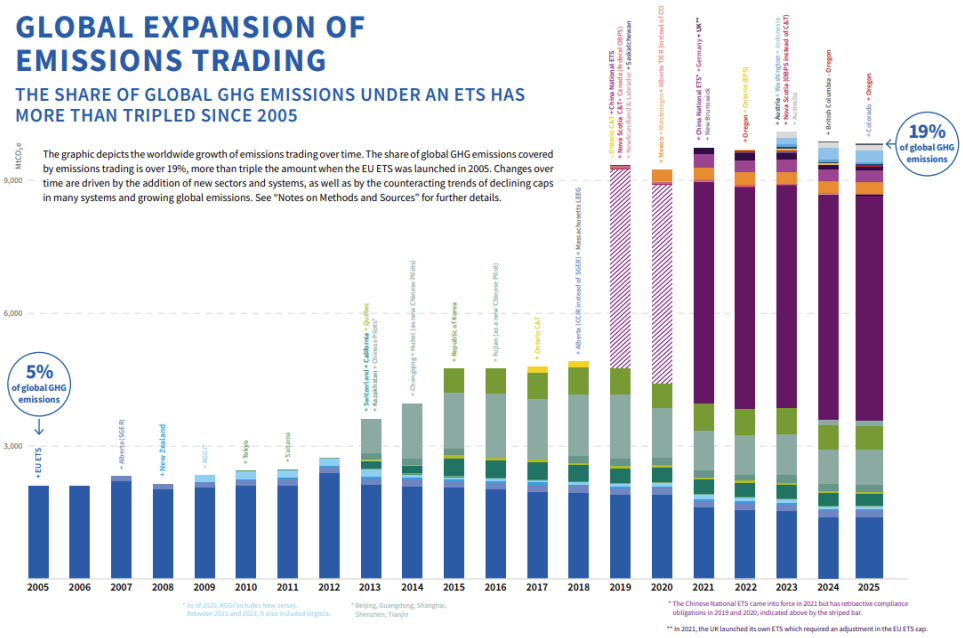
[178] Export intensity here is a ratio based upon the following calculation: (export value) / (production value). Export value refers to extra EU without the UK, Switzerland or EEA countries.

[179] Emission intensity is expressed in kg CO_2 / EUR and is calculated based upon the following: (direct carbon cost / GVA).

Carbon pricing outside the EU

Figure 29 shows that the number of jurisdictions with carbon pricing has increased considerably so production costs in third countries now also include carbon costs.

Figure 29: Global expansion of emissions trading



Source: ICAP[180]

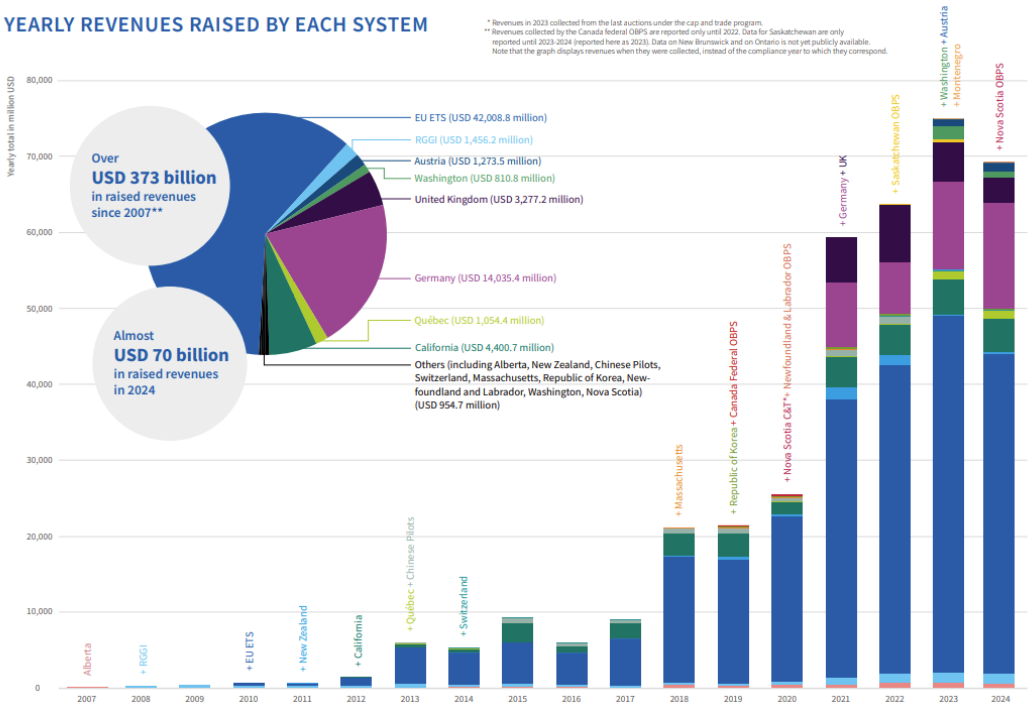
Figure 30 shows that carbon pricing instruments outside of the EU show considerable regional diversity in both price levels and coverage of emissions, though many jurisdictions are positioned for price increases as their systems mature. In Asia, Japan's carbon tax remains significantly lower than the EU ETS price, while South Korea's ETS has experienced price volatility but is expected to stabilise and potentially increase as market mechanisms strengthen. China's national ETS, still in its early stages, maintains relatively low prices, focusing on compliance, but plans to expand sectoral coverage and implement price adjustments, which could eventually see prices increase. Indonesia, having just launched its ETS, has low price levels, but these could increase as the system matures.

In the Americas, California and Québec operate linked ETSs with prices above USD 50 per tCO_2e, positioning them closer to EU ETS levels, though still below the EU average. Argentina and Mexico currently have lower prices through modest taxes targeting fossil fuel combustion, but ongoing discussions around sectoral expansions and price floor adjustments could increase prices over time. Canada's comprehensive approach, which includes both federal and provincial carbon pricing, has already seen some provinces approach EU price levels, with further increases expected as climate targets tighten. Emerging markets like Brazil and Uruguay are also in the early stages of establishing ETSs, with frameworks that have the potential to drive higher prices in the medium term as mechanisms are refined, and market confidence builds.

180 ICAP Status Report 2025, Emissions Trading Worldwide, https://icapcarbonaction.com/system/files/2025-04/250409_icap_sr25_final_1.pdf

In Africa, South Africa's carbon tax remains well below EU ETS levels, yet the government has signalled intentions to increase the rate, aligning it more closely with international benchmarks. Similarly, countries like Kazakhstan and Ukraine, which have introduced carbon pricing mechanisms at relatively low levels, are expected to gradually increase prices as market structures solidify and policy frameworks evolve.

Figure 30: Annual ETS revenues across different systems



Source: ICAP

While most carbon pricing instruments outside the EU currently cover a limited share of emissions, many jurisdictions are considering expanding sectoral coverage and tightening caps, indicating a clear trajectory toward higher prices and broader coverage over time, aligning more closely with the comprehensive approach seen in the EU ETS. The comparability of these schemes is, however, difficult to determine and, in many cases, the carbon price is significantly lower than the EU. In several key trading partners, it is unlikely that carbon costs are equivalent to those faced by operators in the EU ETS and therefore the provision of free allocation remained relevant to supporting the competitiveness of European industrial production. However, Figure 33 above shows that auction revenues are increasing in international systems too suggesting that free allocation provision is in decline.

- EQ2: Is there evidence whether or not carbon leakage actually happened since the start of the EU ETS?

Short term competitiveness channel

The empirical literature on carbon leakage in the context of the EU ETS presents a complex, but increasingly compelling picture. Earlier research, based largely on datasets covering the first phases of the EU ETS, generally found little or no evidence of significant leakage. This result is consistent across different methodologies, including trade flow analyses, sector-level and firm-level assessments. The most commonly accepted explanation for these findings is that the combination of very low carbon prices and the generous allocation of free allowances

during the early stages of the EU ETS significantly reduced any incentive for companies to relocate production or shift emissions outside the EU. Studies such as Naegele & Zaklan (2019) and Dechezleprêtre et al (2022) found no significant evidence that the EU ETS prompted displacement of emissions to countries outside the EU, neither through trade flows nor through adjustments within multinational corporate structures. Similarly, literature reviews like Grubb et al (2022) concluded that existing climate policies have not been substantially undermined by carbon leakage.

However, more recent studies benefitting from updated data, have started to detect clearer signs of carbon leakage. These studies tend to focus on more recent periods, where the EU ETS was more stringent, carbon prices were higher, and free allocation was reduced.

Wang & Kuusi (2024)[181] show that, although the overall effect remains small relative to total trade, there is a measurable increase in the carbon content of imports to the EU, rising by 13% and offsetting a 12% reduction in the carbon content of EU exports.[182] Similarly, a study by Misch & Wingender (2024)[183] use panel data on country and sector specific changes in effectives energy prices to identify changes in domestic carbon emissions and other flows.[184] Short-term carbon leakage rates[185] from unilateral policies were then subsequently derived in the study based upon a simple accounting framework to reflect short run responses of carbon flows to energy price changes. A carbon leakage rate of 0.15 is estimated for the EU14+ group,[186] pointing to a modest but statistically significant evidence of carbon leakage. Another study focusing on the risk of carbon leakage from the French carbon tax by Känzig et al. (2024)[187] highlights that carbon leakage may also occur through multinational firms, showing that emissions from African subsidiaries of French multinationals grew by 2.4 times more than emissions from German subsidiaries, at times when the French carbon tax was higher.[188] Further evidence on the risk of carbon leakage is shown a study by the OECD (2024).[189] The

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181 Wang M. & Kuusi T., 2024. "Trade flows, carbon leakage, and the EU Emissions Trading System", Energy Economics, June 2024, https://www.sciencedirect.com/science/article/pii/S0140988324002640

182 The empirical analysis uses a gravity model on a sectoral level based on the use of international manufacturing trade flows for 2000-2018 from the UN Comtrade database and subsequently combine the trade value data with data on emission intensities of imports from the OECD's 'Carbon dioxide emissions embodied in international trade' database.

183 Misch & Wingender, 2024. Revisiting carbon leakage", Energy Economics, December 2024, https://www.sciencedirect.com/science/article/pii/S0140988324004948

184 The analysis relies upon 1) the OECD's Trade in Embodied CO2 Database to measure carbon emissions and carbon embodied in goods and services trade and final demand and 2) sectoral energy prices based on a dataset compiled by Sato et al. (2019). Merging the two datasets results in an unbalanced panel data at an annual frequency that covers 38 countries and 21 sectors over the 2005-15 period.

185 Wang and Kuusi (2024) define the use of a carbon leakage rate by explaining than a value of one occurs when domestic reductions of emissions are fully offset by emissions abroad leaving global emissions unchanged.

186 EU14 + 1 countries include Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and United Kingdom.

187 Känzig et al, 2024. "Carbon Leakage to Developing Countries", https://dkaenzig.github.io/diegokaenzig.com/Papers/kmo_leakage.pdf

188 Känzig et al (2024) construct a unique dataset that combines financial information on multinational firms with exposure to European carbon policies, ownership links in Europe and Africa, information on subsidiary locations, and spatial emissions data. The panel dataset used in the study included more than 1,500 large multinational firms with almost 16,000 unique African subsidiaries spanning the period from 2010 to 2019.

189 OECD, 2025. "How different climate policies affect carbon leakage through trade", available at: https://www.oecd.org/en/publications/how-different-climate-policies-affect-carbon-leakage-through-trade_5819ce91-en.html

study uses a gravity model on trade to empirically find that, as the carbon price difference between importer and exporter countries widens, the emissions embodied in imports also increase.[190] The OECD study shows that the carbon leakage effect is robust even when accounting for variables like fuel prices and exchange rates, suggesting that carbon price asymmetries caused by the EU ETS may result in carbon leakage in globally traded goods, however the overall carbon leakage rates empirically estimated were deemed to be moderate and varied by country and sector.[191]

Despite these emerging findings, the literature widely acknowledges that the design of the EU ETS, particularly the use of free allocation, has played a decisive role in keeping leakage risks relatively contained so far. Free allocation was introduced to shield firms from the full cost of carbon and protect their competitiveness, especially in sectors most exposed to international trade. By offsetting direct emissions costs and reducing the likelihood of cost-pass-through, this mechanism helped prevent significant relocation of production or loss of market share due to carbon pricing. Many studies attribute the limited carbon leakage observed in the earlier phases of the EU ETS directly to this design feature. In conclusion, earlier studies found little evidence of carbon leakage, largely because the EU ETS in its early stages was designed to minimise such risks. However, as the system matures, the carbon price increases, and free allocation is phased out, more recent analyses find small but increasingly significant evidence of carbon leakage. While the overall magnitude remains moderate, studies using different methods and datasets suggests that carbon leakage is becoming more visible, especially in emission-intensive and trade-exposed sectors and potentially through channels like multinational corporate structures.

A report published by Bruegel in 2026[192] argues that the EU ETS has so far been broadly compatible with industrial competitiveness, while stressing that this outcome has depended critically on policy design choices rather than the absence of carbon costs. Drawing on a large empirical literature, it finds that the EU ETS reduced emissions substantially with only modest impacts on firm profitability, employment and output, and no clear evidence of large-scale carbon leakage to date, largely because extensive free allowance allocation and cost pass-through mechanisms muted exposure for energy-intensive industries in earlier phases. However, Bruegel emphasises that generous free allocation has also produced sizeable windfall profits and failed to trigger deep industrial transformation, leaving emissions reductions in industry lagging far behind those in the power sector. Looking forward, the report makes clear that competitiveness concerns stem not from the EU ETS per se, but from the next phase of its implementation: as carbon prices rise, free allowances are phased out and CBAM's ability to protect exporters remains uncertain, EU firms are expected to face growing cost pressures. The central competitiveness message is therefore conditional: weakening the ETS would undermine investment signals and penalise first movers, but maintaining competitiveness requires shifting

[190] The analysis uses a gravity model of trade to provide empirical estimates of carbon leakage rates (defined as the ratio of policy-induced changes in imported emissions to changes in domestic emissions) for 14 manufacturing sectors, 49 countries and a broad set of climate policy instruments, covering the 2000-2020 period.

[191] The median leakage rate was estimated by the OECD at around 3% (i.e. for every 100 tonnes of emissions that reduced domestically from a unilateral increase in climate policies, imported emissions rise by around 3.0 tonnes.

[192] Mramor, T. and S. Tagliapietra, 2026. "Europe's emissions trading system is an ally, not an enemy, of industrial competitiveness", Analysis 03/2026, Bruegel, available at https://doi.org/10.64153/GZCE1979

from a “cap-and-trade” to a “cap-and-invest” logic, using auction revenues more transparently and conditionally to finance industrial decarbonisation rather than permanent compensation.

The impacts of the EU ETS on downstream sectors will depend on the extent to which regulated entities are able to pass through cost on product prices, which can affect customers and businesses operating downstream. However, evidence on impacts of the EU ETS on downstream sectors is limited, and more research is required.

While it was acknowledged by industrial stakeholders that carbon pricing alone was not responsible for changes observed in production and trade, it was widely argued that the carbon cost is unilateral in nature and therefore undermines their short-term competitiveness.

- *Eurofer* advanced the position that free allocation has proven an essential instrument to avoid carbon leakage due to the unilateral EU ETS cost but was only moderately effective against other causes of carbon leakage. In the last few years, the combination of increased carbon and energy costs and the proliferation of global excess capacity has severely impacted the steel sector. Since 2017-2018, the steel sector has lost around 30 million tonnes of production, of which around 10 million tonnes on export markets. While this negative trend is due to the above mentioned several elements, it should be considered in any case as carbon leakage, since it results in higher production by third country producers that are not subject to equivalent climate policy.
- *European Aluminium* believe that there is evidence of carbon leakage for the production of primary aluminium but less clear for downstream processes and this would require further research to determine fully. In terms of carbon leakage, European Aluminium outline that there has been an observable drop in the production of primary aluminium in Europe. For downstream processes there has been an increase in production for semi-fabricated products, but European Aluminium also state that imports have risen. For example, noticeable increase in imports of aluminium wire which needs pure aluminium from primary process to manufacture.
- *Fertilisers Europe* noted that plant closures have been observed in the EU along with production volume reductions not only due to these closures but also due to other operators running at a lower capacity. This is mainly impacting ammonia production, which has declined from around 15 Mt to 10 Mt. This represents a reduction of around one third in recent times. This drop in domestic production has been replaced with the import of products from outside the EU with a higher carbon footprint and therefore this represents, in the view of Fertilisers Europe, carbon leakage.
- *Cement Europe* explained that as competitors such as Turkey can produce cement at a cost of around 65 EUR per tonne – this is substantially less than the average European production cost of around 90 EUR even after subtracting shipping costs. Cement Europe argue that producers in Turkey and Northern Africa do not have a CO_2 cost, have cheaper energy costs and are therefore more competitive and this situation is unlikely to change in the near future. The imported product is mainly clinker & CEM I (which is 95 % clinker – the most energy intensive part of the production process).
- *Cefic* outlined that carbon cost is one of the main elements impacting the business operations in Europe due to its role in the marginal price of electricity. Indirect carbon cost, factored into the company - already high - energy bills is clearly a source of concern. More broadly, energy costs and weak demand remains the top issues for the chemical sector operating in the EU. Compared to the USA, the gas price in Europe (Jan-Mar 2025) is 3.3 times higher, leaving Europe at a competitive disadvantage. The

EU27 chemicals business environment continues to face a limited demand since March 2022.[193] High energy costs and weak demand has a dramatic impact on plant closures.

- *Glass for Europe* confirmed that European production has fallen in the last 15 years quite dramatically whereas global production has increased. While this cannot be attributed to carbon pricing solely and there are clearly many factors that are contributing whether this be the spike in energy prices as a consequence of geo-political events or the abrupt change in international tariff regimes. However, the carbon price is a unilateral cost and there remains a fear within the flat glass industry that a continuation of the recent rising trend in EUA prices will only exacerbate the problems that the industry faces in a very volatile trading environment. In this context, products with low margins means any extra cost will be a great source of concern.
- *CEPI* acknowledge that the last few years have been challenging but it is very difficult to isolate the impact of carbon pricing against a very volatile wider context with industry having to respond to the challenges posed by both the COVID pandemic as well as geopolitical instability and the subsequent impact on energy prices. However, regardless of the contribution of each factor the result has been a loss of market share in recent years with a loss in production capacity and lower levels of employment compared to before the onset of the recent years of volatility.

Investment channel

The question on whether the EU ETS has led to investment leakage, defined as increased firms' investment outside of the EU to avoid carbon costs, has been studied using different methods and firm-level datasets. Koch & Mama, (2019)[194] focus on German multinational firms, combining Bundesbank data on outward FDI with the EU ETS registry[195]. Using a difference-in-differences matching approach, they find no overall effect of the ETS on foreign investment. On average, regulated firms invested just 0.2% less abroad than unregulated firms, although the result is not statistically significant. However, when looking at a subgroup of "footloose" firms (those in less capital-intensive sectors that can shift production more easily), they estimate that FDI outside the EU was about 52% higher compared to unregulated firms, although the confidence interval is quite wide (±47%). These firms also expanded their network of foreign affiliates by 28%, suggesting that while most German firms did not relocate investment, some mobile firms may have started building options for future relocation.

Other studies confirm the picture of modest and selective effects. D'Arcangelo & Galeotti (2025)[196] study a panel of European firms 2005-2012, focusing on greenfield investments as a direct measure of new productive capacity. Their empirical strategy estimates firms' compliance costs and relates them to investment location choices through a discrete choice model. They find that higher expected carbon costs slightly reduce the probability of investing within the EU ETS area, but the overall effect is economically small. In fact, they conclude that the diversion of investments outside the EU is too limited to justify the very large

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193 Chemical Trends Report available at Cefic website.

194 Koch & Mama, 2019. "Does the EU Emissions Trading System induce investment leakage? Evidence from German multinational firms", Energy Economics, June 2019, https://www.sciencedirect.com/science/article/abs/pii/S014098831930132X

195 The study combines panel (sample period: 1999–2013) of firm-level data on outward FDI stocks with a plant-level database detailing which firms operate any installations subject to the EU ETS.

196 Filippo Maria D'Arcangelo, Marzio Galeotti, 2025. "Environmental policy and investment location: The risk of carbon leakage in the EU ETS", https://doi.org/10.1016/j.enpol.2025.114587.

compensations, via free allowances, that have been used to protect firms. Looking at Phase III (2013-20), De Beule, Schoubben, & Struyfs (2022)197 provide evidence of a pollution haven effect. Using data on 358 listed multinationals and their worldwide FDI projects, they show that carbon inefficient firms are significantly more likely to locate investments in countries with weaker environmental regulation. This shift is attributed to rising carbon prices in Phase III, which made compliance more costly and created incentives for relocation. The aforementioned study by Känzig et al. (2024)[198] shows that European firms' domestic investment decreased while overall global investment remained constant, which is consistent with the hypothesis of partial relocation abroad. By contrast, the study by Dechezleprêtre et al. (2022)[199] estimated that the ETS reduced emissions while not only increasing revenues, but also fixed assets of regulated firms, which suggests that firms reinvested domestically in productive assets and efficiency improvements rather than cutting or offshoring investment.

Overall, evidence on investment leakage the literature remains limited and incomplete but large-scale systematic investment leakage has not yet occurred under the EU ETS. Instead, effects are modest and heterogeneous, with some mobile and carbon inefficient firms appearing to have shifted investments abroad, particularly after prices rose in Phase III, while many regulated firms actually increased investment at home.

The extent to which investment leakage has occurred was, however, more strongly suggested as a likely possibility by industry during interviews with stakeholders from all sectors.

- *Eurofer* regard the EU ETS as the overarching instrument to provide the price signal for the necessary investments in the medium term. Investors in EU steel production are aware that if they want their assets to remain viable for the next 30 years that future investments need to be compatible with the ambitious climate policies of the EU. Indeed, in recent years the sector has already seen investments change in response to the price signal of the EU ETS. However, investments are more likely to involve the replacement of existing capacity with new assets rather than retrofitting current assets. The iron and steel sector is impacted by global overcapacity due to an increase in investments in production capacity internationally as more countries wish to capture their own domestic demand, but this is often over-estimated exacerbating oversupply globally.
- *Fertiliser Europe* stated that with regards to evidence of investment leakage, Fertilisers Europe stated that there has been no recent investment in new capacity within the EU, with the last ammonia plant built in the EU was in Slovakia in 2018. In contrast, more investment has occurred outside of the EU and it is already noticeable that the CBAM policy has encouraged new investments in technology abroad to lower the carbon intensity of their production processes. For example, the US has recently invested in blue ammonia with the clear objective of targeting the EU market.
- *European aluminium* noted that since the introduction of the ETS, the EU has lost around 50% of its primary aluminium smelting capacity, with 30% lost since 2008 alone. Several smelters have permanently closed or suspended operations in countries such as Germany, the Netherlands, Slovenia, and Slovakia, citing unsustainable electricity and carbon costs. In 2022, European smelters curtailed over 900,000 tonnes

197 Filip De Beule, Frederiek Schoubben, Kristof Struyfs, 2022. "The pollution haven effect and investment leakage: The case of the EU-ETS", https://doi.org/10.1016/j.econlet.2022.110536.

198 Känzig et al (2024)

199 Antoine Dechezleprêtre, Caterina Gennaioli, Ralf Martin, Mirabelle Muûls, Thomas Stoerk (2021)

of capacity amid soaring electricity and ETS prices, while global competitors including China, India, and the Middle East expanded production using fossil-based power.

- *Cement Europe* highlighted their concern that multinational companies are now investing more in clinker grinders within the EU at the border / coast to receive imported clinker from outside the EU.
- *FuelsEurope* see a clear pattern of refineries in Europe closing over the last twenty years. Around 30 installations have ceased operation with only 85 refineries remaining. As a consequence, there has been a decline in capacity with no new investments in Europe. New refineries are coming on stream in Africa, the Middle East and Asia. While nearly 400,000 b/d of capacity, around 3pc of Europe's total, is scheduled for permanent closure in 2025 outside Europe, the world has added more than 2.5mn b/d of crude distillation capacity in the last three years.
- *CEFIC* commented that progressively they have seen a significant shift in the companies' strategy, passing from a long-term planning to a short-term (2/3 years) due to the dramatically changed context in which they operate in the EU. About 11 million tons worth capacity has been lost because of closure announcements between 2023 and 2024[200].
- *Glass for Europe* see that in recent investment decisions with more flat glass plants opening outside of the EU but close to the EU border.
- *CEPI* emphasise that their members operate on small margins and continue to compete at a global level but warn that the risk of carbon leakage is real and may only be proven when it is too late and industry has relocated elsewhere. Investments are still happening but if you stop having visibility on carbon leakage protection, if free allocation is regarded as being riskier i.e. conditionality – then this may deter future investments.

3. Firm-level evidence indicates that the EU ETS has induced low-carbon innovation among regulated firms, but that these effects have been uneven and limited in aggregate.

4. Calel and Dechezleprêtre (2016)[201] analyse the early years of the EU ETS (covering Phases I and II, 2005–2009) using a matched difference-in-differences design at firm level, exploiting installation-size thresholds to compare ETS and non-ETS firms with similar pre-policy characteristics. They find that ETS firms increased low-carbon patenting by 8–10% on average relative to non-ETS firms, while patenting in other technologies was not crowded out.

5. Complementary evidence from Joltreau and Sommerfeld (2018)[202] reinforces this conclusion, showing that carbon pricing under the EU ETS primarily stimulated innovation responses among firms with higher absorptive capacity and pre-existing technological capabilities, while having little effect on lagging firms or on technological diffusion across sectors. Together, these studies suggest that early ETS phases reinforced existing innovation trajectories rather than triggering broad-based technological change. This interpretation is consistent with the wider synthesis by Grubb et al. (2021)[203], which concludes that carbon

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200 Cefic and Advancy "The Competitiveness of the European Chemical Industry". p.7.

201 Raphael Calel & Antoine Dechezleprêtre (2016)

202 Joltreau, Eugénie; Sommerfeld, Katrin, 2018. "Why does emissions trading under the EU Emissions Trading System (ETS) not affect firms' competitiveness? Empirical findings from the literature", Climate Policy, ISSN 1469-3062, Taylor & Francis, London, Latest articles, pp. 1-19, https://doi.org/10.1080/14693062.2018.1502145

203 Michael Grubb et al, 2021. "Induced innovation in energy technologies and systems: a review of evidence and potential implications for CO_2 mitigation", Environ. Res. Lett. 16 043007, https://iopscience.iop.org/article/10.1088/1748-9326/abde07

pricing and other market-wide demand-pull instruments consistently induce innovation, but tend to deliver incremental and path-dependent outcomes when applied in isolation. The review further highlights the central role of cumulative deployment and complementary policy instruments in translating innovation activity into sustained cost reductions and structural change, implying that carbon pricing alone is unlikely to drive large-scale low-carbon transformation without stable expectations and targeted support measures.

6. In general, evidence of impacts of Phase IV of the EU ETS on patent innovation is lacking, suggesting a need for more research in this field. The evidence provided in this section relates to the previous phases and is complemented by the findings in stakeholder consultation and interviews.

8.3.5 Conclusion

The point of comparison for this section of the evaluation focuses on the introduction of revisions to both the provision of free allocation and indirect cost compensation at the start of Phase IV of the EU ETS in order to prevent the occurrence of carbon leakage. The implementation of these revisions was firstly evaluated before further work was then subsequently undertaken to assess the impact of these changes to the provision of support in terms of the international competitiveness of European producers.

- As a consequence of the revision to free allocation rules, the overall volume of free allowances that has been provided to industry has declined in Phase IV compared to Phase III. This reduction was primarily as a result of a more targeted carbon leakage list, more ambitious benchmarks and the introduction of adjustments to allocation to better take into account changes in activity levels across installations. However, despite these reforms, the share of verified emissions that continue to be covered by free allowances still remains high for the energy intensive sectors.
- With the introduction of further guidance from the Commission in 2021, the maximum state aid payable was reduced to 75 % of the total indirect carbon cost. Some revisions were also made to number of sectors and sub-sectors that were eligible for indirect cost compensation and the provision of the support remained at the discretion of Member States. However, the evaluation demonstrated through a quantitative analysis that the majority of electro-intensive production is located in Member States that provide indirect cost compensation.

With the exposure to a rising carbon price signal likely to have increased for many ETS operators, and without fully comparable carbon prices in key trading partners, the relevance of carbon leakage risk remains, and the focus of the evaluation therefore was to assess a range of evidence to provide further insights into the extent to which carbon pricing is influencing the international competitiveness of European industrial producers.

The evaluation involved detailed consultations with industry via both the OPC and follow up interviews that were further supplemented with quantitative and qualitative assessments of the potential impact of changes to the provision of free allocation and indirect cost compensation on the competitiveness of industry. It was undeniable that industrial output in the EU has declined in recent years and that imports have at the same time increased for a range of emission intensive products. However, the extent to which these observed trends can be attributed to carbon pricing was very difficult to ascertain given the volatility that has been experienced from the start of Phase IV. Indeed, industrial stakeholders themselves acknowledged that the energy price crisis that followed the illegal Russian invasion of Ukraine was more likely to explain the challenging operating environment for European producers. Nevertheless, industry

still strongly argued that the additional unilateral carbon cost has only exacerbated the challenges presented by the recent economic volatility as a consequence of geo-political events.

The risk of carbon leakage will ultimately decline as industry fully decarbonises, however the rate of progress towards this outcome was observed as being more incremental than transformative. While there were examples of the carbon price driving rapid abatement (i.e. the improvements in the specific emissions of adipic acid production), energy intensive production such as hot metal for steel remains very limited. This likely reflects the high share of free allocation that remains available to industry as well as the carbon price not yet reaching a level that would make the more innovative abatement solutions financially viable. Although the more ambitious benchmarks set for Phase IV are likely to have increased the incentives for abatement across industry, the provision of free allocation in high volumes still protects industry from higher levels of exposure to the carbon price signal. However, industry stressed that these abatement solutions will not be realised simply through more exposure to a higher carbon price signal alone and emphasised consistently the need for enabling conditions to be met (i.e. access to low carbon electricity, CCS/CCU infrastructure, demand for low-carbon products) for more ambitious reductions in emissions to be achieved.

8.4 Monitoring, Reporting, Verification and Accreditation (MRVA)

8.4.1 Introduction

The Monitoring, Reporting, Verification, and Accreditation (MRVA) system is a cornerstone of the EU Emissions Trading System (ETS), ensuring the accuracy, transparency, and consistency of emissions data that underpin compliance, market trust, and environmental integrity. Enshrined in Articles 14 and 15 of the ETS Directive and detailed in the Monitoring and Reporting Regulation[204] (MRR) and Accreditation and Verification Regulation[205] (AVR).

This evaluation builds on the 2015 ETS Directive evaluation, analysing the role of the MRVA system as the backbone of the ETS. It assesses the effectiveness of provisions requiring approved monitoring plans, annual verified reporting, and accredited verification oversight. The system supports the annual compliance cycle—monitoring, reporting, verification, and allowance surrender—which sustains the ETS's credibility and efficiency. The legal basis for MRVA derives from multiple Articles of the Directive, Articles 4-7 of the ETS Directive, as well as Article 14 and 16 and Annexes IV and V. These provisions in the ETS Directive establish the requirements for GHG emissions permits, monitoring and reporting obligations, verification and accreditation rules. They also require Member States to impose penalties when operators or aircraft operators are not complying with the said rules. The framework is operationalised through the MRR and AVR, and their subsequent amendments, including those adopted in 2020 and 2022, which refined monitoring rules, improved data quality, and aligned procedures with evolving EU climate policy, including with the changes done to the Renewable Energy Directive. Updates in 2023–2025 (as part of the 'Fit for 55' package) will apply from 2024 and 2025 onwards but fall outside this evaluation's scope.

In addition, guidance and templates were developed and updated to ensure a harmonised interpretation of the MRR and AVR, and to structure reporting across sectors and operators. These reforms increased harmonisation and transparency in the application of MRV requirements, not only because of the increased application of standardised methodologies and tools to facilitate implementation but also because several measures were taken to improve MRVA procedures: e.g., rotation of lead auditors to mitigate the risks to impartiality, update of the AVR as a result of revisions in ISO standards, allowing virtual site visits of the verifier in force majeure circumstances such as COVID-19 pandemic. These revisions show that both regulations are adaptable and flexible to political, environmental and social developments. During the third and fourth trading period also the institutional frameworks and external and internal coordination within Member States strengthened having clearer institutional roles, the increased use of IT systems, strengthened competent authority's procedures to approve monitoring plans, review of reports and inspections. These improvements led to more consistent, transparent, and reliable emissions data across Member States.

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[204] Commission Implementing Regulation (EU) 2018/2066 of 19 December 2018 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council and amending Commission Regulation (EU) No 601/2012. In 2020 and 2022 it was revised for Phase IV of the EU ETS.

[205] Commission Implementing Regulation (EU) 2018/2067 of 19 December 2018 on the verification of data and on the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and of the Council, OJ 31 December 2018, L 334/94. In 2020 it was revised for Phase IV of the EU ETS.

Despite challenges such as varying national capacities and pandemic-related disruptions, the MRVA system remains central to maintaining the environmental and market integrity of the EU ETS and ensuring its continued effectiveness in achieving the EU's climate goals.

8.4.2 Point of comparison

The evaluation of the MRVA system is based on the provisions of the ETS Directive and its related implementing regulations. The key legal provisions of the ETS Directive relevant to the MRVA are:

- **Article 4: Greenhouse gas emissions permits**. Requires that no installation within the ETS scope may operate without a GHG permit issued by a competent authority.
- **Article 5: Application of GHG permits**. Outlines the information that operators must provide when applying for a permit, including a description of activities, emission sources, and monitoring methodology.
- **Article 6: Conditions for and contents of the GHG permits**. Specifies that permits must include monitoring and reporting requirements, and that operators must comply with conditions laid down in the permit.
- **Article 7: Changes relating to installations**. Requires operators to notify the CA of any planned changes that may affect emissions or the permit's validity, triggering update to the monitoring plan.
- **Article 14: Guidelines for monitoring and reporting of emissions**. Provides the legal mandate for the Commission to adopt detailed rules on monitoring and reporting, which provide the legal basis for the Monitoring and Reporting Regulation.
- **Article 15: Verification and accreditation of verifiers**. Requires that emissions reports be verified by accredited independent verifiers and provides the legal basis for the Accreditation and Verification Regulation.
- **Article 16: Penalties**. Establishes the enforcement regime, including penalties for non-compliance with MRVA obligations, such as failing to surrender allowances equal to verified emissions.

In line with Articles 14 and 15 of the ETS Directive, the Commission has adopted a series of implementing measures to operationalise the MRVA framework. These implementing acts provide technical rules and procedures to ensure the accurate quantification, reporting, and verification of emissions. The key implementing measures for MRVA are the 2018 Monitoring and Reporting Regulation and the 2018 Accreditation and Verification Regulation, which replaced earlier versions of the legislation and introduced a more robust, flexible, and harmonised system with compliance and oversight. Since their implementation, several amendments have been made to address practical challenges, including the improvement of data quality and the alignment with evolving technical standards. These implementing regulations and their amendments are key points of comparison for this evaluation. More specifically, the legislation we will be referring to include:

- Commission Implementing Regulation (EU) 2018/2066 of 19 December 2018 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council and amending Commission Regulation (EU) No 601/2012
- Commission Implementing Regulation (EU) 2018/2067 of 19 December 2018 on the verification of data and on the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and of the Council

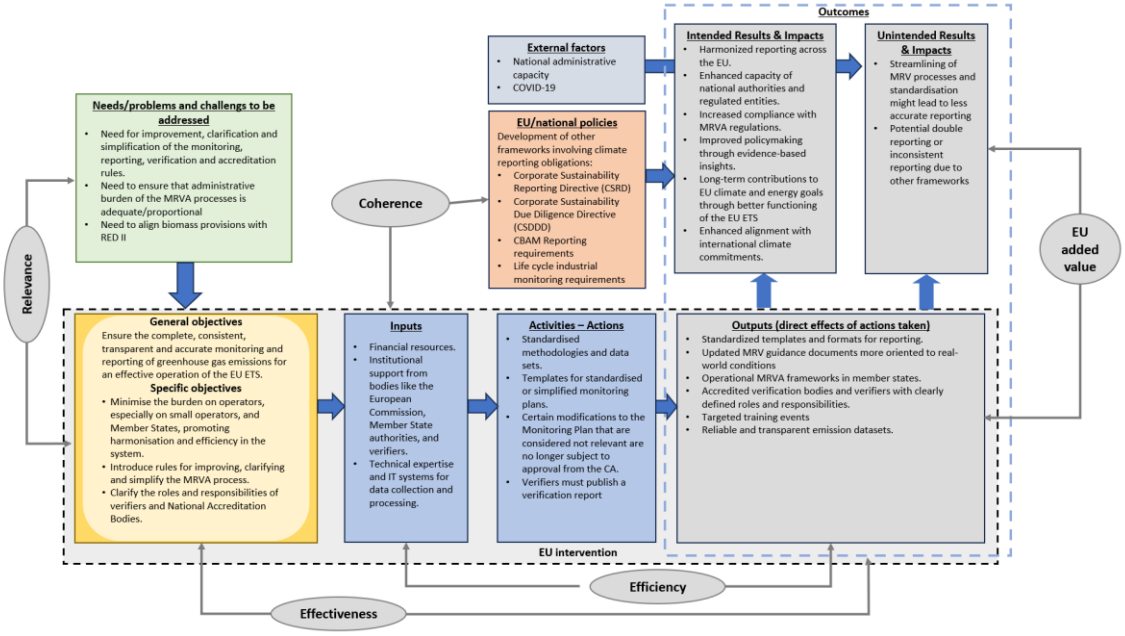
- Commission Implementing Regulation (EU) 2020/2085 of 14 December 2020 amending and correcting Implementing Regulation (EU) 2018/2066 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council
- Commission Implementing Regulation (EU) 2022/388 of 8 March 2022 amending Implementing Regulation (EU) 2018/2066 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council
- Commission Implementing Regulation (EU) 2020/2084 of 14 December 2020 amending and correcting Implementing Regulation (EU) 2018/2067 on the verification of data and on the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and of the Council.

From the period 2020 to 2023 the MRR and the AVR were also amended to improve the effectiveness of MRV of emissions and to align with other EU ETS legislation. One of the key amendments was the incorporation of a stronger link between the MRR and the REDII, regarding biomass sustainability, the clarification of provisions on how to monitor zero-rated biomass fuels, and revisions to simplify certain elements of the monitoring process: e.g., allowing operators not to submit an improvement report, if the improvement report was only necessary to ensure that non-conformities in accordance with Article 69(4) of the MRR were being managed and that these non-conformities had already been resolved. The revised requirements in the MRR on biomass also had an impact on the verification requirements in the AVR. Provisions were included to clarify the verifier's role in assessing the evidence of the operator. Further changes in the AVR included virtual site visits of verifiers in the case of force majeure circumstances, and rotation of lead auditors that have carried out verification for the same operator of the installation for five consecutive years. Other changes in the AVR included revisions that were made to incorporate the new harmonised verification standard, ISO 17029 and the updated standard ISO 14065 that are used by accreditation bodies to accredit verifiers.

In the years 2023 to 2025 both the Monitoring and Reporting Regulation and the Accreditation and Verification Regulation underwent significant revisions. Among other things MRV requirements were included for the new ETS scheme on road transport, buildings and additional sectors, MRV of non-aviation effects for aircraft operators and new requirements because the scope of ETS activities in Annex I of the Directive has extended (e.g. transfer of CO_2 through other modes than pipelines). These new revisions are however out of scope of this evaluation.

8.4.3 *Intervention logic*

Figure 31: Intervention logic diagram (MRVA)



Source: Own illustration

8.4.3.1 Problem to address

A reliable and efficient system for monitoring, reporting, verification, and accreditation (MRVA) is fundamental to the effective functioning of the European Union Emissions Trading System (EU ETS). Without a robust MRVA framework, the accuracy and transparency of emissions data may be compromised, undermining the environmental integrity of the system.

There is a clear need to ensure that the administrative burden associated with MRVA processes is proportionate. This is crucial to maintain the integrity of the EU ETS while also supporting the overarching goal of reducing greenhouse gas emissions. This calls for balance between administrative efficiency and regulatory robustness.

Another issue is the alignment of existing MRVA provisions, particularly those concerning emissions from biomass, with updated legislation such as the revised Renewable Energy Directive (RED II). This alignment is necessary to ensure consistency across EU climate and energy policies.

In addition, the costs associated with MRVA processes, which fall on competent authorities, operators, and verifiers, must be examined using real market data. This analysis is vital to understanding the financial implications and ensuring cost-effectiveness across the system.

8.4.3.2 Objectives

The general objective is to ensure the complete, consistent, transparent, and accurate monitoring and reporting of greenhouse gas emissions. This is essential for the effective operation of the EU ETS. A key part of this objective is to operationalise and implement changes introduced by revisions to the ETS Directive within the MRVA framework.

Further specific objectives include:

- Minimise the administrative and financial burden on operators (especially small emitters) and on Member States, while promoting harmonisation and increased efficiency in the MRVA system.
- Improve, clarify, and simplify MRVA procedures to enhance user-friendliness and reduce complexity.
- Clearly define the roles and responsibilities of verifiers and National Accreditation Bodies to improve accountability and ensure high-quality verification processes.

8.4.3.3 Inputs

The successful implementation and enhancement of the MRVA framework depend on several key inputs:

- Financial resources - Adequate funding is required to support both the development and operational phases of the system. This could include funding from Member States as reported under Article 21.
- Institutional support - Collaboration and support from the European Commission, national authorities, and verification bodies are vital for effective coordination and enforcement.
- Technical expertise and IT systems - High-quality data collection and processing depend on specialised knowledge and robust information technology infrastructure.

8.4.3.4 Actions

A series of targeted actions have been taken to strengthen the MRVA framework, with the aim of improving efficiency, consistency, and accuracy across the EU ETS.

- One of the key measures has been the introduction of standardised methodologies and data sets for both operators and aircraft operators. This standardisation supports harmonised data reporting and reduces discrepancies in emissions monitoring.
- To further reduce the administrative burden, templates for standardised and simplified monitoring plans have been developed, enabling more streamlined preparation and submission processes, particularly for small emitters.
- In terms of regulatory simplification in Phase 2 and start of Phase III, certain changes to the monitoring plan that are considered not significant no longer require formal approval by the competent authority (CA), thus reducing administrative delays and improving procedural efficiency. Additionally, verifiers are required to issue a verification report that must comply with harmonised rules in the Accreditation and Verification Regulation and that must contain information on outstanding issues identified in the verification, enhancing transparency and accountability.

Several legislative amendments have also been introduced to align MRVA provisions with updated climate and energy policies.

- Under the revised Monitoring and Reporting Regulation (MRR), the emission factor for biomass is set to zero, reflecting its nature as a renewable source. For biofuels not physically delivered to the site of combustion, aircraft operators may determine the biomass fraction based on purchase records, provided they can prove there is no double counting of emissions reductions. Furthermore, Member States could choose not to apply GHG sustainability or emissions saving criteria for biofuels, bioliquids, and biomass for the year 2022, reflecting a transitional compliance approach.

- The 2020 amendments to the Accreditation and Verification Regulation (AVR) introduced updated rules granting CAs greater access to internal verification documentation, thereby strengthening oversight.
- In response to the challenges posed by the COVID-19 pandemic, verifiers are now permitted to carry out virtual site visits in exceptional, unforeseen circumstances, ensuring business continuity.
- Additionally, a new requirement mandates the rotation of EU ETS lead auditors to maintain objectivity and prevent conflicts of interest in verification practices.

8.4.3.5 Outputs

The implementation of these actions has yielded several important outputs that contribute to the overall functionality and reliability of the MRVA system.

- A centralised MRVA framework has been established in the Monitoring and Reporting regulation and Accreditation and Verification Regulation which harmonised the requirements across Member States.
- Member States implemented more strengthened MRV procedures to manage MRV processes, ensuring that the revised rules are embedded within national procedures.
- Standardised templates and reporting formats have been developed, accompanied by adaptable IT tools that accommodate the varying operational contexts of Member States. These tools and templates promote uniformity while allowing for a degree of flexibility to meet national needs.
- Updated MRV guidance documents have also been produced, focusing more on practical, real-world implementation scenarios. This shift ensures that stakeholders, from operators to verifiers, are better equipped to navigate compliance requirements.

The framework also includes clear provisions for the accreditation of verification bodies, with well-defined roles and responsibilities. This clarity enhances accountability and strengthens institutional capacity.

A series of targeted training events has been launched to support the consistent application of MRVA rules and to build technical competence among all relevant actors. As a result, the MRVA system now generates emissions datasets that are not only reliable and consistent but also transparent, enabling informed decision-making and public scrutiny.

8.4.3.6 Intended results and impacts

The intended outcomes are a more harmonised and cost-effective MRVA system that strengthens data integrity, policy relevance, and international alignment. Improved verification quality and reduced administrative burden should enhance trust and comparability across the EU ETS. However, simplification carries some risks—such as potential data loss or inconsistencies with overlapping EU frameworks (e.g., Industrial Emissions Directive, Renewable Energy Directive, CBAM)—highlighting the need for ongoing coordination and interoperability.

The anticipated outcomes of the revised MRVA framework are both immediate and long-term. In the short term, the reforms aim to ensure harmonised and reliable greenhouse gas reporting across the EU, fostering consistency and comparability among Member States. The capacity of national authorities and relevant stakeholders is expected to increase, enabling them to more effectively implement, monitor, and enforce MRVA-related requirements.

The changes are also designed to facilitate the mutual recognition of verification bodies across borders, reducing duplication and administrative burden while promoting trust and cooperation among Member States. Enhanced clarity and training are expected to lead to higher compliance rates with MRVA regulations, thereby reinforcing the integrity of the EU ETS.

Improved monitoring and data quality will provide more robust evidence to support policymaking, ensuring that climate actions are grounded in accurate and verifiable emissions data. In the long term, these improvements are expected to contribute meaningfully to the EU's climate and energy objectives by enhancing the effectiveness and credibility of the ETS. Moreover, greater alignment with international climate reporting standards will position the EU as a global leader in climate governance, further reinforcing the EU's commitments under multilateral agreements such as the Paris Agreement.

8.4.3.7 Unintended results and impacts

While the ongoing reforms and streamlining of the MRVA framework are expected to yield significant benefits in terms of efficiency and harmonisation, certain unintended consequences may also arise. One potential risk is that the drive toward standardisation and simplification could inadvertently reduce the accuracy or granularity of emissions reporting. Simplified methodologies, while easier to apply, may not always capture the complexity of certain operations or sector-specific nuances, leading to possible under- or over-estimations of emissions.

Another concern is the potential for duplication or inconsistencies in reporting due to overlapping climate-related frameworks at both EU and national levels. As multiple regulatory regimes with distinct reporting requirements are included in EU policies, such as those related to Waste Framework Directive, Industrial Emissions Directive and to some extent, corporate sustainability reporting, there is an increased risk of double reporting. This could lead to confusion among stakeholders and undermine the coherence and comparability of emissions data across systems.

These unintended effects underscore the importance of ensuring interoperability between frameworks and of maintaining flexibility within the MRVA system to account for sectoral and national specificities without compromising the integrity of emissions data.

8.4.3.8 External factors

The effectiveness of the MRVA in achieving its goal might be affected by external factors, including variability in national administrative capacity, which might have affected the uniform application of MRVA processes across Member States, and the COVID-19 pandemic, which posed significant challenges, disrupting inspections, verifications, and site visits due to travel restrictions and safety concerns.

8.4.3.9 EU/national policies

The MRVA framework operates within an increasingly complex policy environment shaped by both EU-level and national legislative developments. Several emerging and evolving policy instruments are introducing new climate-related reporting obligations that potentially interacted with, or overlap, the requirements of the EU ETS.

At the EU level, the Corporate Sustainability Reporting Directive (CSRD) is expanding non-financial disclosure obligations for companies, including the reporting of climate-related risks, absolute emission targets and direct and indirect GHG emissions of a company. The CSRD Directive states that Sustainability Reporting Standards that apply to companies reporting

sustainability information have to comply with EU law, including ETS Directive. Similarly, the Corporate Sustainability Due Diligence Directive (CSDDD) introduces additional expectations for environmental due diligence across value chains, which could influence emissions data tracking and verification processes. Additionally, new frameworks focusing on lifecycle industrial monitoring are being developed, potentially overlapping with MRV processes for industrial installations covered by the EU.

8.4.3.10 Data collection

The evaluation findings rely on several data sources, particularly desk research, as well as surveys, targeted interviews and a reality workshop with key stakeholders.

Literature review focussed particularly on evidence from Article 21 reports, from previous assessments of costs associated with MRVA and other literature on the MRVA.

The surveys with key stakeholders included:

- A survey of stationary installations which resulted in 303 responses.
- A survey of Competent Authorities which resulted in 18 responses.
- A survey of 21 verifiers.
- A survey of 4 National Accreditation Bodies.
- A survey of Article 27 installations.
- A survey of aircraft operators.

Five anonymous semi-structured interviews were conducted with selected CAs and NABs. These interviews provided qualitative insights into the practical functioning of the MRVA system during Phase IV in relation to the evaluation criteria, with a particular focus on effectiveness and efficiency.

Finally, the analysis also draws on the outcomes of a reality check workshop with stakeholders, which was used to validate emerging findings, test preliminary conclusions and identify areas of convergence and divergence across stakeholder groups.

8.4.4 Evaluation findings

8.4.4.1 Effectiveness

The **effectiveness** criterion evaluates how successfully the EU ETS MRVA system has fulfilled its objectives of ensuring robust, transparent, consistent, and accurate monitoring and reporting of greenhouse gas emissions from industrial installations and aircraft operators. It examines four main aspects: the accuracy, completeness, and transparency of emissions data and the system's ability to prevent errors and misreporting; the effectiveness of the verification and accreditation processes in ensuring reliable data and compliance with EU ETS rules; the extent to which Member States have improved MRVA procedures and how these improvements have influenced overall compliance; and finally, how well the MRVA system has adapted to emerging challenges and what further enhancements could strengthen its effectiveness. The criterion covers four evaluation questions related to the effectiveness of the monitoring and reporting system, as well as the verification and accreditation, the improvements proposed by MSs and the adaptability to new challenges.

- EQ1: Effect of the MRVA system on accuracy, completeness and transparency on EU ETS GHG reporting data

Evaluation Question 1 assesses whether Phase IV MRVA arrangements as they applied from 2021-2023 produce accurate, complete and transparent emissions data across Member States

and sectors. The analysis draws primarily on MRVA survey data, complemented by Article 21 reports, targeted consultation inputs and other sources.

The MRVA system delivers high harmonisation and accuracy with standard methods used almost universally. Across Member States and sectors, operators and aircraft operators generally apply the MRR's required methodologies using the tier approach.[206] Most stationary installations, apply a calculation-based methodology using the tier system whereas a limited number of installations use continuous emissions monitoring systems (CEMS) used where appropriate. The use of fall-back approaches remains marginal, covering only 3.6% of surveyed installations[207] and only 0.3% of all installations in 2022.

For aviation, convergence in applied methodological approaches is even stronger: 85% of aircraft operators use Method B[208] for fuel consumption calculation, and 90% of small emitters apply the Eurocontrol EMIS[209]. This harmonisation is reinforced by change-control rules for monitoring plans that require Competent authority approval of significant modifications and notification of non-significant ones. Article 21 reports record only seven penalties in 2022 for failures to notify changes, indicating that arbitrary methodological changes are rare.[210]

Use of Commission templates and guidance by competent authorities

Use of Commission templates further encourage convergence, with 25 competent authorities reporting that they made use of the Commission's templates for monitoring plans, emission reports, verification reports, and improvement reports, while three countries combined these with national-specific formats.[211] Among the surveyed competent authorities, 83% of respondents (15 out of 18) indicate that they made use of the Commission guidance for stationary installations for Phase IV.[212] . Interviews with CAs and NABs corroborate this by highlighting that Commission forms and guidance help reduce recurring clarification requests from operators and support more harmonised implementation over time. However, some interviewees also noted that the late release of Commission templates and guidance, combined with delays in the availability of national-language versions, can create implementation challenge. Still, overall, these harmonised approaches enhance the consistency and comparability of data across Member States and ensure that standardised methodologies are applied uniformly by operators or aircraft operators.

Completeness and accuracy of EU ETS emissions data

The MRVA system ensures that nearly all emissions from Annex I activities are monitored and reported, with only marginal delays or omissions. Article 21 data show that only a very small share of installations fails to submit verified emission reports by the 31 March deadline. Where

206 Interviews with Competent Authorities

207 Survey of stationary installations (n = 303)

208 Method B is one of the two fuel consumption calculation methods defined in Annex III of the Monitoring and Reporting Regulation. It relies on direct data from aircraft fuel purchase or uplift records, providing higher accuracy than Method A, which is based on estimated fuel consumption derived from flight data.

209 The Eurocontrol Emissions Monitoring and Inventory System is an online small-emitters tool that estimates fuel burn and CO_2 using Eurocontrol flight movement data and standardised algorithms. It is recognised under the MRR for eligible small emitters, easing compliance by providing consistent, traceable inputs for monitoring and verification

210 European Commission, 2024. "Analysis of national responses under Article 21 of the EU ETS Directive" (data reported in 2023, reflecting the situation in 2022)

211 Ibid

212 Survey of competent authorities (n =18)

reports are not submitted in time, conservative estimates are applied in line with Article 70 of the MRR, ensuring coverage continuity. Only 25 installations in 2022 required such estimates. These trends confirm that, despite some technical or administrative challenges in isolated Member States, the MRVA framework effectively safeguards near-complete emissions reporting coverage under the Directive.

Emission data under the EU ETS remain consistently accurate and complete, with residual uncertainties tightly controlled. Across both stationary installations and aviation operators, the share of conservative estimates has remained below 1% of total verified emissions throughout Phase IV, confirming that most emission reports are based on data that is verified as satisfactory. In 2022, only 61 installations (less than 0.8% of all covered facilities) required conservative estimation, primarily due to delayed submissions or negative verification opinions. Completeness of reporting is also near universal, with only 111 failures to submit verified emission reports by the 31 March deadline in 2023, equivalent to roughly 1–1.5 % of all stationary installations. Although this represents an increase from 67 cases in 2021, the absolute number remains low and is concentrated mainly in two Member States[213]. Negative verification opinions (around 30 per year) and report rejections (about 50 annually) are similarly infrequent.[214] Together, these indicators demonstrate that nearly all Annex I emissions are accurately monitored, verified, and incorporated into the ETS registry, reflecting a robust MRVA framework that ensures reliable and comprehensive greenhouse gas reporting and forms a solid basis for surrendering allowances that cover reported emissions.

Monitoring plan approval and change procedures have remained stable and well understood since 2020. All Member States conduct completeness, and consistency checks on verified emissions reports, with 14 conducting a detailed analysis of all AERs for stationary installations. Aviation shows even higher consistency, with 25 countries performing systematic cross-checks aided by Eurocontrol's EMIS database and 17 countries conducting detailed analysis of all AERs for aircraft operators.[215] Enforcement evidence confirms the robustness of the system. In 2022, only 42 penalties were issued to stationary installations across nine countries, about 0.5 % of all covered installations, and nine aviation infringements were recorded across five countries. Excess-emission penalties were imposed on 41 operators (up from 29 in 2021).[216] At the same time, participants in the EU ETS reality check workshop mentioned that, for stationary installations, monitoring plan approval and change processes can involve non-negligible administrative effort. They reported that minor monitoring plan updates, such as technical like-for-like (e.g. installation of new instrumentation of equivalent quality), can trigger full re-documentation and re-approval cycles, with limited perceived added value for emissions integrity.[217] Still, the low infringement rates, combined with consistent preventive measures, indicate that Phase IV has consolidated a mature, multi-layered control framework that maintains high data quality and compliance across the EU ETS.

- EQ2: Has the verification and accreditation system been successful in delivering robust implementation of the EU ETS

EQ2 assesses how effectively the EU ETS verification and accreditation framework ensures the successful implementation of the EU ETS, by providing confidence in the accuracy of

213 Germany and Poland, accounting for 65 % of all cases
214 European Commission (2024)
215 Ibid
216 Ibid
217 EU ETS Reality Check workshop

emissions data and compliance with monitoring requirements. It draws primarily on MRVA survey data, Article 21 reports, EU ETS Compliance Forum discussions and inputs, and targeted consultation inputs.

NABs maintain consistent and effective supervision of verifiers under AVR and ISO 17029/14065 standards. According to the MRVA survey, three of four NAB respondents (75 %) stated that the effectiveness of their risk-based surveillance had remained unchanged, while one (25 %) reported a slight improvement. None observed deterioration. This suggests that NABs have maintained a strong, targeted approach to supervising verifiers (e.g. focusing on higher-risk areas without any drop in stringency). This is consistent with some of the interviews, which characterised the accreditation and surveillance framework as effective in upholding verification quality, supported by close cooperation with the competent authority and verifiers (including regular alignment meetings) and only minor non-conformities observed in practice.[218]The dedicated survey among competent authorities further did not flag that there are quality concerns with the accreditation work by NABs. None of the 18 surveyed competent authorities report that they had to take corrective action against NABs in the period of 2021-2023.[219] Peer evaluation reports by the European Cooperation of Accreditation also do not show any major non-compliance of NAB's activities with the AVR and the harmonised standards. This demonstrates continued confidence in the accreditation framework in delivering robust supervision.

Constraint on verifiers capacity and impartiality risks

Regarding verifier independence, the surveyed NABs generally perceived that impartiality risks (such as conflicts of interest) remained steady in Phase IV. None of the surveyed NABs further reported a worsening trend, with one NAB observed that impartiality had improved significantly.[220] Nevertheless, Compliance Forum discussion does show that the constraints on verifier capacity increase concerns on the impartiality of verifiers. In recent years, competent authorities in the Compliance Forum have identified more cases where there are unacceptable conflicts of interests for verifiers and staff involved in verification activities. This concern is echoed by targeted consultation with competent authorities, where one CA raised concrete impartiality issues observed in practice, including cases where verifier organisations were part of larger corporate groups that also provided consultancy services to ETS operators through other branches. One the other hand, operators participating in the reality check workshop, while acknowledging familiarity risk, also reported that continuity of verifiers is beneficial for effectiveness, particularly for complex installations, as long-standing verifier engagement reduces onboarding time, and improves the efficiency and quality of annual verifications.[221]

Sanctions against verifiers

Formal sanctions against verifiers (such as suspension or withdrawal or reduction of scope of accreditation) have been very rare, which can be interpreted as a sign that verifiers largely adhere to the rules and ethical standards. According to the Article 21 data, most countries reported zero sanctions in recent years. In 2022, only two suspensions[222] and one accreditation withdrawal (France) were recorded across all EU ETS countries, plus one respective case where

[218] Interviews with NABs
[219] Survey of competent authorities (n = 18)
[220] Survey of NABs (n = 4)
[221] EU ETS Reality Check workshop
[222] In France and Norway

NABs reduced or withdrew verifier's scope of accredited activities to address performance issues (Denmark and Romania). This is a decrease compared to 2021, where ten sanctions have been reported to be issued. This very limited level of enforcement actions by NABs is also identified in the MRVA survey, albeit with a small sample size, in which none of surveyed NABs indicated having suspended, withdrawn or reduced the accreditation scope of verifiers.[223] In addition, only 72 non-conformities in the assessment of verifiers were identified in 2022, up from 54 in 2021 but still at a low number. Complaints against verifiers declined, from 49 in 2020 to 28 in 2021, spiking temporarily to 202 in 2022 (mostly due to backlog of previous year) before falling back to low double-digit levels by 2023. All 2022 complaints were resolved within the year, reflecting responsive oversight.[224] Taken together, the evidence indicates that NABs' risk-based supervision effectively upholds verifier quality and impartiality while maintaining efficiency across the EU ETS.

Quality of verification activities

Verifications continue to be the cornerstone of the EU ETS assurance framework, providing systematic, independent checks on reported emissions data. Under the AVR, accredited verifiers are required to perform on-site visits for each installation, and evidence confirms that these remain the norm across Member States. Even during the COVID-19 pandemic, when travel restrictions were widespread, remote verifications were limited: only 637 installations and 25 aircraft operators, around 7.5 % of all stationary installations, were audited remotely with competent authority approval. By 2022, this number had dropped sharply to just 31 remote audits as normal conditions resumed.[225]

The survey data confirm that on-site visits are done rigorously, typically by 1 – 4 EU ETS (lead) auditors, depending on the complexity of the operators. However, some respondents noted that travel time and compressed verification calendars can pose logistical challenges, particularly during peak reporting periods. Reflecting on this, a number of respondents suggested that a more proportionate, risk-based approach could be introduced, allowing simplified or remote audits for low-risk or small emitters, while maintaining comprehensive on-site checks for complex or high-emission installations.

Such flexibility already exists within the AVR but is tightly controlled. Under Articles 31–32, site visit waivers may only be granted for simple or low-emitting installations that meet strict criteria and obtain prior competent authority approval.[226] Article 21 data confirm that these waivers remain rare: only 48 and 53 installations (out of approx. 8 500 – 9 000 installations in total) emitting more than 25 kt CO_2 received them in 2021 and 2022, respectively.[227] Evidence from targeted consultations reinforces this picture. Operators from the reality check workshop noted that simplified monitoring regimes often do not translate into materially lighter verification practices in practice. Several operators reported that, even where installations qualify as low emitters, verification approaches frequently remain largely unchanged, including requirements for on-site presence. However, it was also noted in the interviews that small installations do not always apply simple monitoring methods or have robust quality control measures in place. Survey responses from verifiers seem to indicate that most of these

[223] Survey of NABs (n = 4)
[224] European Commission (2024)
[225] Aggregated data from Article 21 Analyses of national responses under Article 21 of the EU ETS Directive, reflecting the situation between 2015 and 2023
[226] Approval of the competent authority is not required for installations with low emissions.
[227] European Commission (2024)

verifiers start the verification already in the reporting period which leaves sufficient time to close misstatements, non-conformities and non-compliance issues that are identified in the verification. While verifiers largely endorse the current verification approach, some respondents express a desire for targeted simplifications or more flexible, risk-based procedures to ease administrative and time pressure for small or low-risk emitters. Overall, the evidence generally points to a high-quality and robust verification audit system.

Misstatements, non-conformities and non-compliance in verification outcomes

While the absolute number of reported misstatements, non-conformities and non-compliance issues fluctuates from year to year, their overall share remains small relative to the 8500 – 9000 of verified reports submitted annually. Across the EEA, misstatements increased moderately from 142 in 2015 to 336 in 2023, but this upward trend is almost entirely driven by one Member State228 France, which alone accounts for about one third of all reported cases. When France is excluded, the number of misstatements remains stable, oscillating between 87 and 126 over the same period. Non-conformities show a similarly steady pattern, ranging between 859 and 1 090 cases during 2015 - 2023, with a gradual decline (from 510 to 306), when France that represents 31 % of all cases is excluded. The same holds for non-compliance issues, which remain within 315 - 448 annually outside France, but display a mild upward trend at EEA level due to French figures, which make up about 35 % of the total. In total, Article 21 data show that only 10 negative verification opinions in 2021, 30 in 2022, and 6 in 2023 were issued across nearly 9 000 verified reports, equivalent to less than 0.5 % of all verification cases. Similarly, since 2021, the level of rejected AERs has been stagnant with an annual average of about 53 rejections, amounting to around 0.6 %. Overall, these trends point to a mature and stable MRVA system that consistently identifies a limited number of discrepancies, while the French outlier could reflect intensified verification scrutiny or country-specific implementation issues rather than a systemic deterioration in data quality.

Information exchange between CAs and NABs

In addition to the annual surveillance of the verifier by the NAB, the requirements in Chapter VI of the AVR for the NABs and competent authorities to exchange information in relation to verifiers have significantly improved the overall oversight on the quality of verification[229]. In general, the requirements in Chapter VI function effectively where a NAB and the competent authority are located within the same country. When the information exchange occurs across borders when a verifier accredited by a NAB is carrying out verification in another country, there are still some opportunities to improve this information exchange. Not all reports are submitted in time, and one NAB indicated in the survey responses that a harmonised approach on what constitutes a complaint on verifier would be helpful as it could simplify the complaint procedures of NABs.[230] Targeted consultations with competent authorities illustrate these cross-border challenges in more detail. One CA reported that work programmes and management reports for verifiers accredited in other Member States, is not always transmitted in practice, despite being formally required. A different CA highlighted practical difficulty in

[228] France

[229] NABs that has accredited a verifier are required to submit work programmes to the competent authority of the country in which the verifier is carrying verification by 31st of December on the planned activities of the accreditation body and a management report by 1st of June on results of accreditation activities. In turn competent authorities must report relevant results from the review of emission reports or inspection or complaints on verifiers to the NAB so that they can this into account in their surveillance.

[230] NAB survey (n = 4)

identifying appropriate contact points within foreign NABs complicating cross-border verifier oversight.[231]

The robustness of the oversight is shown by the low number of non-conformities and complaints on verifiers. In 2022, eight countries reported a total of 72 non-conformities in their information exchange. This was a slight uptake in the number of countries compared to 2021 with 54 non-conformities reported. The types of non-conformities noted were generally issues like shortcomings in the internal verification documentation, misinterpretation of a guidance detail, or procedural gaps by verifiers, pointing to an absence of pervasive problems. When non-conformities are identified, verifiers are required to correct them, and most are resolved promptly. Of the 72 non-conformities found in 2022, about 66% were already addressed and closed by the time of reporting.[232]

Confidence in the robustness of the system is high among those closest to it. Competent authorities report that verified data are dependable enough to be used directly for compliance assessments and international greenhouse gas inventories, demonstrating institutional trust in verification outcomes. Interviewees confirm that the MRVA system is stable and robust in practice.[233] NABs likewise confirm that the system functions well, with none identifying fundamental weaknesses; all respondents note quality as stable or improving.[234] Among installations and aircraft operators, confidence in verification quality remains high, but views on procedures related to verification at installation level are mixed: in the MRVA survey, 40 % of installations disagreed that verification had improved or been simplified since Phase III, and 36 % saw no change.[235] Qualitative feedback highlight the added documentation requirements for the operators under new Phase IV rules. Some of this feedback also relates to requirements for free allocation. The increased verifier's role on checking the operator's evidence of compliance with sustainability and greenhouse gas savings criteria under RED II is also mentioned.

Verifiers' capacity

Furthermore, verifier capacity is generally tightening. Both Article 21 reports and the 15th EU ETS Compliance Conference and discussions in the Compliance Forum highlight staff shortages and resulting pressure on verifiers. For example, the German Competent Authority warned that the convergence of new reporting obligations in 2026 (EU ETS AERs, annual activity level reports, municipal waste incineration AERs, and the first ETS2 AERs and climate-neutrality reports), combined with retirements among experienced staff, risks creating a shortage of qualified verifiers. With 110 verifiers for stationary installations and 20 for aviation in 2022, current capacity is tightening.[236] The targeted consultations corroborate this finding. At least one competent authority and a handful operators in the reality check workshop reported difficulties in securing verifiers with the appropriate accreditation scope and sectoral expertise within the required timelines, noting that highly seasonal verification peaks and limited off-season work exacerbate these challenges and raised concerns that the ongoing expansion of the EU ETS could further strain capacity.[237] This is also true for accreditation

[231] CA interviews
[232] European Commission (2024)
[233] CA interview
[234] Survey of national accreditation bodies (N = 4)
[235] Survey of installations (N = 303)
[236] European Commission (2024)
[237] Interviews with Competent Authorities and EU ETS Reality Check workshop

assessors within the national accreditation body that are assessing the competence, impartiality and performance of verifiers in accreditation and surveillance. To ensure quality of the accreditation and verification system it is therefore important to monitor not only verifier resources but also the capacity within accreditation bodies as system complexity and workload increase. In essence, the MRVA system has a high level of trust, but the anticipated strain on verifier resources, coupled with the evolving demands of new reporting obligations, underscores the need for proactive capacity planning. Ensuring sufficient verifier and accreditation assessor capacity will be critical to maintaining the trust in the system as the scope of the EU ETS expands.

- EQ3: Impact of improvement of procedures by MS and their impact

EQ3 assesses how effectively Member States have improved their MRVA procedures under Phase IV of the EU ETS and the resulting impact on coordination, review, accreditation, and enforcement. The question focuses on whether these procedural improvements have strengthened oversight, consistency, and compliance, or whether capacity and coordination challenges persist.

The coordination framework under the EU ETS has reached a high level of procedural maturity, enabling stronger consistency in MRVA implementation within and across Member States.

Evidence from the MRVA survey shows that three competent authorities reported improved coordination with NABs and other agencies in Phase 4, while most noted no change, reflecting continuity in established administrative practices. Where improvements occurred, they were typically procedural, such as revised internal templates to facilitate complaint handling with NABs or enhanced tools for Annual Emission Report (AER) checks and monitoring plan approvals by the competent authority. Nearly all respondents confirmed relying on the Commission's guidance (used to at least a moderate extent by 88 % of competent authorities for stationary installations and 76 % for aviation), underlining the harmonising influence of EU-level support materials. Only one respondent explicitly noted monitoring or technical issues regarding stationary installations for MRVA. These concerns focused on the new requirements on waste incineration, zero-rating of biomass fuels, CCU, CCS, and the linkage between EU ETS 1 and ETS 2 introduced under 'Fit for 55'. Findings from the competent authority interviews point in the same direction. Interviewees noted procedural continuity between Phase III and IV and have also adopted a regular use of the Commission's guidance documents. However, they note that clarifications on new requirements can arrive on short notice and also explicitly mentioned waste incineration and zero-rating of biomass fuels as difficult to implement.[238] Overall, the evidence suggest that coordination have been stable and largely effective from Phase III to Phase IV, with procedural refinements providing a foundation for consistent compliance oversight, while implementation challenges exist for newly introduced requirements.

Organizational structure of the authorities

The internal organisation of competent authorities demonstrates overall stability and sufficient adaptability to national administrative contexts. According to Article 21 reports, 19 Member States apply either fully or largely centralised models for EU ETS implementation in Phase IV, while 12 Member States continue to operate more decentralised arrangements involving regional or local authorities.

[238] Interviews with Competent Authorities

Where responsibilities are decentralised, coordination mechanisms have been reinforced to ensure consistency, including regular inter-authority meetings, structured working groups, and shared training or guidance. For aviation, nine member states have assigned MRV responsibilities to authorities other than those responsible for stationary installations (e.g. ministries of transport or air traffic agencies). This reflects different political or administrative arrangements for the aviation sector. Internal coordination within competent authorities has also strengthened over time through measures such as peer review of monitoring plan approvals, IT systems, structured meetings and checklists, tailored to national circumstances and the number of installations and aircraft operators covered.

Overall, these arrangements indicate a high level of procedural maturity, enabling Member States to balance efficiency and consistency with flexibility for national administrative particularities.

Monitoring plan approvals, use of harmonised templates and review of emission reports

Strict approval procedures and harmonised templates ensure a consistent and non-arbitrary application of monitoring methodologies across the EU ETS. Under the MRR, all significant changes to monitoring plans (such as adding emission sources, changing the monitoring methodology, adjusting tiers or changing source streams) require prior approval from competent authorities, preventing arbitrary deviations in the application of the monitoring methodologies. Article 21 data show that non-compliance with the MRR is low: in 2022, only seven penalties were issued EU-wide for failures to report changes to the monitoring plan, out of roughly 9,000 installations and aircraft operators.

Both Article 21 reports, as well as other studies such as the Compliance Cycle Evaluation study in 2018 and the Compliance Enforcement study in 2021 and 2022 show several Member States take preventive measures to ensure a high compliance rate of stationary installations, e.g. sending reminders, active communication with stationary installations during the monitoring plan approval procedures and notification procedures. Stakeholder feedback confirms that operators face no major difficulties with monitoring plan procedures.[239]

Complementing these controls, the ***Commission's harmonised templates and guidance*** have played a key role in aligning practice: in 2022, 25 countries used the common templates for monitoring and reporting, while three combined them with national formats[240], and all surveyed competent authorities report relying on Commission guidance to a varying extent. 56% (nine out of 16) and 62% (eight out of 13) of competent authorities engaged with the MRVA of respectively stationary installations and aircraft operators further rely on Commission guidance to a significant extent.[241] Digital tools further strengthen consistency, with 14 competent authorities (eight of 18 surveyed competent authorities[242]) using the ERT in 2025.

Perceived simplification needs of the monitoring process from stakeholders

Feedback from operators highlights a perceived need for further simplification. Approximately 46% of installations disagreed that monitoring procedures were simplified under Phases 4, and 39% felt the same for reporting procedures. Only 10% agreed that reporting procedures

239 European Commission (2024)

240 European Commission (2024)

241 Survey of competent authorities (N = 18). Among these, eleven are responsible for the MRVA of both stationary installations and aircraft operators, four only for stationary installations and three only for aircraft operators

242 Survey of competent authorities (N = 18)

improved, and just 6% agreed that monitoring procedures improved. While the permitting and MP approval systems function effectively from the perspective of competent authorities, operators generally perceive limited simplification.[243] The stationary installations present at the EU ETS reality workshop raised similar concerns. They reported that the monitoring plan approval and update of monitoring plans can be burdensome where small "like-for-like" changes (e.g. small equipment replacement without material emissions impacts) to monitoring plans required full re-documentation/resubmission. Large operators with multiple source streams also questioned why very small emission points are subject to documentation and scrutiny like that applied to major streams.[244] As such, while Phase IV has made positive strides in efficiency, there still appears to be room for improvement in reducing perceived administrative complexity for operators. However, from the comments in the survey some of the perceived complexity may relate to free allocation.[245]

Inspection and enforcement practices

Survey and Article 21 evidence indicate that inspection and enforcement procedures by competent authorities have remained largely stable in Phase IV, reflecting the maturity of existing oversight systems. Improvements were modest: among competent authorities responsible for stationary installations, three of sixteen (19%) reported enhancements to inspection procedures, while the rest noted no change. For aviation, two of thirteen authorities (15%) reported slight progress. Enforcement practices followed a similar trend, with four stationary competent authorities (25%) and three aviation competent authorities (23%) citing procedural improvements. Open comments in the survey report improvements to internal streamlining, expanded use of IT-based monitoring tools, or more systematic follow-up processes.[246]

Inspection activity continues to be well embedded across the EU. In 2022, 27 of 30 participating countries conducted on-site inspections of stationary installations, often integrated with Industrial Emissions Directive (IED) reviews. Nine Member States combined IED inspections with additional ETS-specific checks, while eight carried out dedicated ETS inspections. It is noted that countries with only IED inspection without covering any ETS specific elements only provide a high-level inspection not necessarily picking up any non-compliance with monitoring plan procedures. Four Member States had yet to establish regular inspection routines due to legal or capacity constraints. A total of 210 inspections were conducted in 2021 and 230 in 2022, indicating a risk-based strategy in which authorities targeted higher-risk or larger installations and those with anomalies in emission data. Complementing these efforts, many competent authorities employ preventive compliance measures such as automated reminders, helpdesks, and IT-based alerts to ensure timely submissions and corrective actions.[247] Taken together, the evidence points to a well-institutionalised and steady inspection and enforcement framework, delivering consistent assurance of compliance with small and gradual efficiency improvements. However, also in this area capacity constraints within competent authority's organisation did have an impact on the frequency on inspections in the more recent years. Furthermore, participants in the

[243] Survey of stationary installations (n = 303)
[244] EU ETS Reality Check Workshop
[245] Survey of stationary installations (n = 303)
[246] Survey of competent authorities (N = 18)
[247] European Commission (2024)

workshop did mention that inspection on top of verification can sometimes lead to administrative burden.

- EQ4: Adaptiveness of the MRVA to new challenges

EQ4 assesses the extent to which the MRVA system has been able to adapt to new challenges over time, including changes in the scope of the EU ETS, the inclusion of new sectors, activities and greenhouse gases, and emerging technical or administrative challenges. It examines whether the MRVA framework has remained sufficiently flexible and responsive to ensure continued robustness, consistency and effectiveness of the MRVA system.

Implementing Regulation (EU) 2018/2066 and Implementing Regulation (EU) 2018/2067 respectively introduced the MRR and AVR requirements for Phase IV of the EU ETS in 2018. Implementing Regulations are directly applicable in all Member States and require no transposition. A review of EU infringement proceedings identified no cases related to the implementation of these MRVA rules. The infringements observed were linked to broader EU ETS transposition delays rather than MRVA-specific deficiencies. For example, Austria INFR (2019)0295), Ireland (INFR (2019)0327), and Italy (INFR (2019)0329) were subject to procedures for non-communication of measures. Furthermore, Poland (INFR (2020)0091) only partially transposed the Directive, and Luxembourg (INFR (2019)0331) received a formal notice for not having notified any implementing measures. Similar cases occurred in Spain, Portugal, Belgium, Romania, Bulgaria, and others. All these infringement cases were eventually closed prior to the start in Phase IV. The overall evidence therefore confirms that Member States successfully embedded the 2018 MRVA requirements within their administrative systems, maintaining legal coherence and continuity with the wider EU ETS framework.

Between the years 2020 and 2022, the MRR and AVR were amended to address emerging challenges such as the COVID-19 pandemic, integration of the RED II, and the international CORSIA scheme for aviation. Implementing Regulation (EU) 2020/2084 introduced provisions for virtual site visits under force majeure, ensuring verification continuity during travel restrictions.[248] Implementing Regulation (EU) 2020/2085 clarified biomass definitions and sustainability criteria under RED II[249], while Implementing Regulation (EU) 2022/388 was adopted stating Member States or competent authorities may allow operators or aircraft operators to delay the demonstration of compliance of zero-rated biomass with compliance with RED II sustainability criteria in 2022.[250] This extension allowed certification schemes to became fully operational and verifiers sufficiently trained. The related guidance for biomass issues was updated in October 2022.[251]

Stationary installation feedback on free allocation and Activity Level Change verification

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[248] Commission Implementing Regulation (EU) 2020/2084 of 14 December 2020 amending and correcting Implementing Regulation (EU) 2018/2067 on the verification of data and on the accreditation of verifiers pursuant to Directive 2003/87/EC, https://eur-lex.europa.eu/eli/reg_impl/2020/2084/oj/eng

[249] Implementing Regulation (EU) 2020/2085, amending and correcting Implementing Regulation (EU) 2018/2066 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC

[250] Implementing Regulation (EU) 2022/388, amending Implementing Regulation (EU) 2018/2066 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council, https://eur-lex.europa.eu/eli/reg_impl/2022/388/oj

[251] Guidance Document Biomass and other zero-rating under the EU ETS, https://climate.ec.europa.eu/document/download/2289952b-4d59-494c-8c49-c0a559c403d6_en?filename=gd3_biomass_issues_en.pdf

Feedback from stakeholders points to increased administrative burden, particularly linked to free allocation and Activity Level Change verification. Participants from stationary installations at the EU ETS reality check workshop reported that ALC reporting templates are very extensive, covering all sectors within a single spreadsheet, with many fields not relevant for individual installations. Certain parts of the templates were also described as difficult to complete in practice, for instance sections requiring the reporting of a single representative value for carbon intensity. Operators further highlighted that the benchmarking-related inputs under ALC and free allocation are burdensome to populate, while transparency on how benchmarks are established and how reported data contribute to benchmark value-setting remains limited. The respondents framed it as a "one-way" information flow, where operators provide extensive data but "do not learn" from the benchmarking exercise. Finally, the workshop participants described the first-quarter reporting period as a concentrated compliance bottleneck where MRVA reporting collide with financial closure and other reporting obligations.[252] Evidence from the Open Stakeholder Consultation for the evaluation of the EU ETS and MSR reinforces the perceptions shared in the reality check workshop. The executive summary highlights the need for simplifying monitoring, reporting, verification, and accreditation as one of the key findings. Private sector and SME respondents proposed harmonised digital tools, automated data collection, and simplified compliance obligations, such as longer verification cycles or higher opt-out thresholds (e.g. raising the equivalent-measures threshold from 25,000 tCO_2 to 50,000 tCO_2 per year). While such proposals could lower costs and ease compliance, they raise trade-offs with accuracy, comparability, and environmental integrity. Any future simplification should therefore be risk-based and proportionate, ensuring that efficiency gains do not compromise the credibility and harmonisation of the EU ETS MRVA framework.

Timing of regulatory updates

Feedback from the survey and interviews evidence presents both positive and negative perspectives on the timeliness and clarity of regulatory updates in the AVR and MRR for the preparation of Phase IV. As previously mentioned, the Commission's guidance documents have supported the clarity of Phase-4 regulatory updates. Nearly all surveyed competent authorities report using them (88% with stationary remits; 76% with aviation). One verifier also describes clearer expectations and a more organised workflow for operators, and three note that internal/external training improved preparedness.[253] This positive assessment is supported by both CA and NAB interviews, with at least three interviewees explicitly mentioning the Commission's guidance to have improved regulatory clarity and harmonisation for Phase IV. That said, timeliness and clarity concerns recur in both competent authority and verifier feedback. From the competent authority survey, two competent authorities point to continuous legislative changes and delays in publishing templates and guidance. Verifiers echo these challenges: Two respondents explicitly cite late and frequently changing templates and documentation, while one verifier links late provision of legal requirements to compressed planning and extra effort. Two other verifiers also stress compressed calendars and tight reporting deadlines. Overall, competent authorities and verifiers recognise the guidance's value for clarity but raises issues about the clarity and timeliness of regulatory updates.

The Open Stakeholder Consultation for the evaluation of the EU ETS and the MSR also raise concerns about the timeliness of regulatory updates to the MRV framework. Respondents (not

[252] EU ETS Reality Check workshop
[253] Survey of verifiers (n = 21)

quantified, as the question was open-ended) stressed the need for more timely and proactive guidance from the Commission on forthcoming MRV updates. They noted that delays in communicating new requirements had led to inefficiencies in adjusting internal compliance systems, highlighting the importance of early information and clear transitional arrangements. Operators also called for improved access to information and greater transparency on planned regulatory changes to allow sufficient time to adapt their monitoring and reporting procedures effectively.

Participants in the EU ETS reality check workshop report relying on a combination of channels to stay informed about regulatory updates, including communications from national competent authorities, industry and trade associations, consultants, peer networks within corporate groups, and the European Commission's guidance documents and tools. Industry associations and consultants are frequently described as key intermediaries, particularly for translating regulatory changes into operational implications, while smaller installations report limited internal capacity. Across participants, a recurrent concern is that regulatory updates, clarifications and templates are often communicated late in the compliance cycle. Operators further highlight that frequent changes to reporting requirements, templates and related guidance undermine efforts to digitalise and automate MRV processes, as significant effort is required to repeatedly adapt internal IT systems and data workflows to reflect regulatory changes. While operators generally view Commission guidance positively and consider it an important reference point, some report that its non-binding status can slow implementation in practice. Several installations report of instances where that national authorities are cautious in relying on guidance documents and instead prioritise national transposition of legislative acts. Some multinational companies present at the workshop operating installations in several Member States mentioned that in some specific cases there were divergent national approaches to implementation and application of new rules, increasing complexity across jurisdictions.[254]

Overall, while the Commission's guidance and training materials have supported regulatory understanding and harmonisation, the recurrent concerns over timing and complexity underscore the need for more predictable update cycles.

8.4.4.2 Efficiency

Both MS and ETS operators incur costs for the MRVA of the EU ETS; MS through the competent authorities and accreditation bodies administrating the requirements and ETS operators[255] fulfilling the monitoring and reporting requirements and paying for the verifier to have their emission report verified. Earlier studies on the administrative costs have found that these costs are reasonable and proportional in relation to the environmental benefits.[256] Of these studies the most recent have been carried out for maritime, but studies for aviation and stationary installations were carried out before 2020 (this latter referred to as the 2016 administrative cost report in this section). [257]

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254 EU ETS Reality Check workshop

255 Installations and aircraft operators

256 European Commission, 2025. "Supporting study for the implementation of the ETS Directive and MRV requirements for maritime transport", https://climate.ec.europa.eu/document/download/a069517b-4fcc-4263-84f5-b527fafded91_en?filename=Report+on+MRV+extension+to+vessels+below+5000+GT.pdf&utm_source=chatgpt.com

257 Evaluation of EU ETS Monitoring, Reporting and Verification Administration Costs, 2016

- EQ5: Cost-efficiency of the MRVA system, and opportunities for cost reduction

Evaluation question 5 asks whether the MRVA system has achieved its objectives in a cost-efficient manner and whether there are opportunities for cost reductions.

Monitoring

The survey asked operators of stationary installations and aircraft operators to provide information on costs that are connected to the annual monitoring and reporting cycle.

Annual costs are all costs that an operator or aircraft operator incurs every year when monitoring emissions including:

- Maintaining the data management system, the control system and procedures.
- Calibration of measurement equipment and carrying out other quality assurance and control activities.
- Making sure internal staff continue to be competent (e.g. regular training and capacity building).
- Dealing with changes to the monitoring plan.
- Communicating with the competent authority when notifying changes to the monitoring plan and obtaining approval of significant changes to the monitoring plan.

Respondents from stationary installations indicated that more than 60% of the days dedicated to monitoring activities were for monitoring of emissions and maintaining the data management systems and control system and monitoring procedures. A similar split was indicated for aircraft operators. Monitoring of emissions was also the largest cost in previous reports.

Most relevant responses for both stationary installations and aircraft operators stated that monitoring costs had increased slightly or remained constant between Phase III and Phase IV. Reasons given for the increases include inflation, rising costs of external consultants and the requirements to demonstrate compliance of biomass with sustainability rules. The MRVA requirements for free allocation for stationary installations are also mentioned which is a separate consideration in this evaluation.

Reporting

The costs for reporting are primarily annual expenses related to drafting emission reports. If required by Article 69 MRR, [258] these costs also include drafting improvement reports, obtaining approval for these reports, and communicating with the competent authority to address issues reported in the verification report, especially if there are misstatements, non-conformities or non-compliance issues.

According to the survey, respondents from both stationary installations and aircraft operators indicated that around half of their full-time working days were spent gathering data for emission and improvement reports. About 30% of the time of stationary installations was

[258] Improvement reports are required in the case lower tiers are allowed because of unreasonable costs and technical infeasibility or a fall-back approach is applied. In those cases, operators must regularly report on their opportunities to improve the monitoring methodology and move up to higher tiers. The reporting interval depends on the category of the installation. According to Article 69(4) of the MRR operators are also required to submit an improvement report, if the verifier has reported non-conformities and recommendations for improvement in the verification report. Such improvement reports are not required if all the non-conformities were addressed before that time.

dedicated to drafting the emission report, including correspondence with the competent authority, and the remaining time was spent on improvement reports. The time spent on improvement reports for aircraft operators is significantly lower as aircraft operator only have to submit an improvement report if non-conformities or recommendations for improvements have been listed in the verification report.

Approximately equal numbers of aircraft operators reported that reporting costs had either increased significantly or remained constant between Phase 3 and Phase IV. The significant cost increases were attributed to reporting on data from sustainable aviation fuel[259], although relatively few aircraft operators use biofuels compared to stationary installations, [260] or to factors not directly related to the EU ETS, such as Brexit[261]. However, due to the relatively high number of "do not know" or "not applicable" responses, the sample size of relevant responses for aircraft operators is small.

For stationary installations, a larger proportion overall reported a slight increase or that costs had remained constant. Less than 15% of respondents mentioned significant cost increases, and where explanations were given, these were mostly linked to free allocation.

Verification

The costs associated with verification are incurred by operators or aircraft operators due to the need:

- To provide the verifier with access to evidence and information needed to carry out verification as well as access to the control system and procedures.
- Answer questions of the verifier and follow-up on requests from the verifier.
- Accompany the auditor during the site visit of the verifier of the installation or the aircraft operator; and
- Correct issues identified by the verifier during the verification.

Furthermore, the operator of the installation or the aircraft operator pays a verification fee for services of the verifier.

Respondents for stationary installations indicated that for more than half of the installations, site visits required the most effort, whereas for aircraft operators follow up of issues took most time. More than half of the aircraft operator respondents to the survey emit less than 25ktonnes and Article 33 of the AVR[262] allows for waiving site visits for such aircraft operators, which may explain the difference. Another reason is that site in the aviation sector is defined as the location where the monitoring process is defined and managed, therefore much more compact than in the industry sectors where a site can consist of multiple locations.

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259 This includes demonstrating compliance of the sustainable aviation fuels with sustainability and greenhouse gas savings criteria.

260 European Commission (2024)

261 Because of Brexit, aircraft operators carrying out intra-EEA flights that were originally administered by the UK competent authority had to be re-attributed to other Member States which might have caused some administrative costs for those aircraft operators in the years 2020. Furthermore, the changes of scope of EU ETS flights because of Brexit might have had an impact on the internal processes within the aircraft operator in collecting the necessary data for reporting and ensuring completeness of EU ETS flights. Only intra-EEA flights and flights from the EEA to the UK and from the EEA to Switzerland are included in EU ETS whereas flights from the UK to the EEA and Switzerland to the EEA fall into the UK ETS and Swiss ETS respectively.

262 Implementing Regulation (EU) 2018/2067, available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02018R2067-20250622

For stationary installations, most respondents indicated that verification costs have either increased significantly or slightly. In contrast, for aircraft operators, most of the relevant replies suggest that verification costs have remained constant.

For stationary operators, the cost increases were attributed to additional checks required by verifiers to assess compliance with the sustainability and greenhouse gas savings criteria of the RED II Directive, the rising complexity of control and monitoring activities, and an increase in verification fees or the number of days needed by the verifier. Stationary installations are increasingly using biomass fuels and the amendments in the REDII Directive in 2021 extended for example the applicability to solid biomass which caused more installations to have to demonstrate compliance of biomass fuels with the sustainability and greenhouse gas saving criteria. This was in particular the case in the year 2023 as in 2022 Member States could allow operators not to demonstrate compliance.

The OPC did not include specific questions on MRVA but in some cases, respondents have made relevant comments. There are around 70 unique responses from industry associations, NGOs and aircraft operators where this is the case (out of 377). The majority from industry associations and aircraft operators stated that the administrative burden associated with the MRVA was high. However, like the survey many of these related to the processes involved by free allocation. The responses also indicated that the requirements on accuracy of metering contributed to cost and that delays in responses from CAs resulted in lengthy processes and consequently more costs. Some responses mentioned that verification processes were onerous, but it is not clear whether this also related to verification for the purposes of free allocation.

For most aircraft operators and around half the stationary installations, MRV costs represent less than 30% of the overall administrative cost related to the EU ETS. For installations that do not receive free allocation, the main costs of compliance relate to purchase of allowances rather than administrative MRV costs. For a smaller number of both aircraft operators and stationary installations the MRV costs represent more than 50% of administrative cost. Of the stationary installations more than half of these are in the sector combustion activities and about equally split between the different size categories of installations. There is therefore no clear explanation of why the administrative costs for these installations are a higher proportion of overall cost. The sample size for aircraft operators is too small to draw conclusions.

Stationary installations MRV costs

Respondents to the survey reported averages for MRVA costs and staff days. For stationary installations, the average costs across all categories of installations for monitoring were 58 000 EUR , for reporting 27 000 EUR and for verification 9 000 EUR . Data differentiated by sector, size of installation and country group is discussed under EQ6. These costs are significantly higher than previously identified, partly related to rising labour rates and inflation of equipment prices. Additionally, some costs related to MRVA for free allocation have been included in the estimates given. The implications for MRVA costs per CO_2 are discussed below.

The highest annual costs and number of working days are for monitoring activities which aligns with the activities that installations have carry out according to the MRR.

A standard cost approach has been used to extrapolate to the EU level and put the reported costs in context. Based on this methodology, total costs for operators of stationary installations range from 0.2-0.9 billion EUR. When expressed as cost per tonne emissions, this gives a range

of 0.2 to 0.8 EUR/tonne CO_2.[263] These costs per tonne CO_2 are higher than in the 2016 administrative cost study, which gave an average of 0.16 EUR per tonne CO_2. This seems to contradict the views expressed in the survey and discussed above on the change in costs between Phase III and Phase IV.

Part of the difference between the 2016 study and this one may be the slightly different scope and formulation of the questions in the survey. Additionally, at the high end of the range particularly it may be there is some double counting amongst the costs, for example between total cost and external cost. However, it is also possible that some efficiencies, for example through implementing standard tools, more harmonisation between Member States and improving guidance, may have been offset by additional requirements in some areas that led to higher costs such as the RED requirements discussed previously. It should be noted that not all responses were clear-cut. Even though some stakeholders indicated that the requirements related to metering for stationary installations have become more cost intensive, there is no clear reason for that emanating from the regulation. Compared to 2016 the rules on measurement of fuel consumption or material production as well as the rules on sampling and analysis have not changed significantly

Aircraft operators

The reported annual costs for aircraft operators are smaller than those for stationary installations (respectively 25K for monitoring and 17K for reporting), except in the case of verification fees (12K) which are higher than for stationary installations. In the calculation-based methodology employed in the aviation sector, the fuel consumption for each EU ETS flight and each fuel is multiplied by the applicable emission factor. Mirroring the sector as a whole,[264] most aircraft operators responding to the survey used method B for MRV. However, only a small proportion used the small emitters tool or Eurocontrol EMIS. Nevertheless, the relatively more straightforward monitoring and reporting requirements for the aviation sector contribute to lower costs.

In line with the costs, the days spent by aircraft operators on different MRV activities are generally lower than for stationary installations except for activities associated with verification. The costs are significantly higher than the MRV costs discussed in the 2014 aviation report, but that focused on small emitters.[265] The sample size in the survey for this study is not high enough to distinguish small emitters.

The sample size in the survey is also too small to allow meaningful disaggregation, so total costs at the EU level have been calculated without disaggregation. Based on 378 active aircraft operators, total costs ranged from EUR 12 – 20 million. With total emissions of the aviation sector of 54 $MtCO_2$ in 2023, the costs range from EUR 0.2 - 0.4 per tonne CO_2. These are lower than for stationary installations, as would be expected.

Competent authorities MRV costs

The competent authority's costs in relation to MRV can also be distinguished between one-off costs at the start of a trading period when new requirements are introduced and annual costs concerning the continuous management of EU ETS MRV processes. The one-off costs relate

[263] Based on total emissions from stationary installations in 2023 taken from Article 21 reporting.

[264] According to the Article 21 reporting, 85% of AOs use method B.

[265] PwC, 2014, "ETS Aviation small emitters", https://cedelft.eu/wp-content/uploads/sites/2/2021/04/eindrapport.pdf

mostly to organising capacity building activities to train and instruct internal staff on new requirements, setting up or adjusting internal processes to new requirements[266] The overall costs will depend on the number and type of installations that are being administered and the organisation of the competent authorities themselves. Annual costs for the competent authorities are mostly related to:

- continuous capacity building activities (e.g. structured training activities, standardised working groups or meetings, maintenance of the helpdesk and for some competent authority maintenance of national IT system)
- addressing notifications of changes to the monitoring plan and approval of significant changes to the monitoring plan
- reviewing annual emission reports and verification reports that are submitted by the operator to the competent authority.
- inspection and enforcement.

Nearly 40% of respondents indicate costs for MRV for stationary installations have increased slightly between Phase III and Phase IV and around 20% that they have remained constant.

The reported costs (321 K euro) and days (725) for competent authorities for MRVA of stationary installations are significantly higher than the 2016 administrative cost study. This is also in contrast to the views expressed on cost changes between Phase III and Phase IV. It is possible that competent authorities included costs related to free allocation in their estimates, which increases the scope of their activities. Furthermore, competent authorities were already taken preparatory measures in 2022-2023 to prepare themselves for the scope extensions in EU ETS in 2024 and 2025 by hiring new staff, implementing new tools such as IT systems and changing procedures. Cost increases can also be explained by the fact that most Member States strengthened their procedures to review annual emission reports and inspection procedures and Competent Authorities had to update themselves on the strengthened rules of zero-rating biomass fuels.[267] The costs for MRV procedures for aircraft operators are lower at 65K.

For competent authorities, total costs can be calculated based on either average costs or the number of working days giving a range of 7-13 million EUR.[268] Although these are larger than earlier estimates as discussed above, these are small relative to MRV costs for operators of stationary installations. The survey asked respondents about the one-off costs associated with entry into the EU ETS system and capital costs associated with purchase of monitoring and reporting equipment. The estimates provided cover a wide period, depending on when the installation entered EU ETS. Only a few of the survey respondents entered after 2018.

One-off costs for stationary installations and aircraft operators related to monitoring include:

- Training and guiding internal staff on the new MRR monitoring rules.
- Preparing for the implementation of monitoring and reporting practices.

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[266] Adjusting procedures for the approval of monitoring plan to incorporate the new requirements in these procedures, adapting checklists or adapting national guidance.

[267] In 2023 Member States were required to actively enforce the operator's requirement to demonstrate compliance with sustainability and greenhouse gas savings criteria.

[268] It is assumed that there are 30 competent authorities, 27 Member States plus Iceland, Northern Ireland and Norway. Northern Ireland is included as 5 installations are covered by the EU ETS. Liechtenstein is not considered in the cost exercise as there are only 2 installations in Liechtenstein with very low emissions and these installations were considered to being opted out of the EU ETS.

- Drafting the monitoring plan and obtaining approval from the competent authority. Generally, these costs cover not only the drafting process but also the communication with the competent authority during the approval process. For stationary installations there are some additional one-off costs that are not applicable to aircraft operators: these costs relate to obtaining an ETS permit from the competent authority.
- Setting up and implementing the operator's or aircraft operator's control system and procedures. This concerns setting-up and implementing the control activities that are tailored to the risks in the data flow of the installation or aircraft operator and the various procedures that must be designed and implemented to mitigate the risks that control activities are not functioning effectively.
- Additional costs may include the purchase of monitoring equipment and reporting equipment.
- One-off costs related to reporting involve setting up data management systems for collecting emission reporting data. If these systems were already available, the costs would be for adapting them to emission reporting.

Surprisingly, estimates for the **capital costs** associated with implementing technologies for reporting are higher than those for monitoring. Most of these costs are for IT systems, which facilitate both monitoring and reporting processes for stationary installations. With respect to monitoring, the reported expenditure is largely for metering devices.

Respondents to the survey indicated that for stationary installations, drafting a monitoring plan and establishing the control system and procedures are each 30% of the one-off costs on entering the EU ETS system.

For aircraft operators, the average costs for MRV on entering the EU ETS system are around half that of stationary installations. Respondents to the survey reported that purchasing of equipment was the biggest component at around 40%.

As described previously, the Commission periodically revises regulations in response to changes in the Directive and/or to improve the functioning of the MRV system. In addition, guidance and templates for various aspects are regularly updated to adapt to new legislation and to facilitate the implementation of MRV implementation and increase the effectiveness and efficiency of the system. A minority of respondents to the survey mentioned improved guidance, improvement in the reporting platforms and more standardised procedures as improvements between Phase III and Phase IV.

Stakeholders regularly share information on their experiences with the implementing MRV requirements in various fora. In the Technical Working Group on MRV MS Competent Authority's provided input into legislation and guidance in stakeholder consultations. In various CCEGs industry associations can exchange information. Another platform for exchanging information is the Compliance Forum where Member State competent authorities share good practices and discuss practical MRV implementation issues. These stakeholder consultation processes not only contribute to a more effective implementation of EU ETS but also increased harmonisation having a positive impact on the overall efficiency of the MRVA system.

Improvements in monitoring and reporting

In the survey, interviews and reality check workshop respondents mentioned that there are still opportunities for improvements, despite improvements, despite the changes already in the

MRV system and made some suggestions. The options for improvements and streamlining identified by respondents to the survey and OPC broadly fall into the following categories:

- **Changes to the requirements for site visits for verification.** A verifier must carry out a site visit during the verification.[269] Under certain conditions laid down in Articles 31 and 32 of the AVR, a site visit may be waived for stationary installations. Conditions for waiving site visits in the aviation sector are included in Article 33 of the AVR. In practice the number of site visits waived for both stationary installations and aircraft operators is relatively low.[270] It was suggested that more site visits should be waived or conducted remotely, or the frequency of site visits could be reduced, for example where the technological characteristics of a site are unchanged.
- **Changes to deadlines.** Operators must submit verified emissions reports to competent authorities by 31 March of the year following the reporting year. The deadline for submitting improvement report is 30 June. If an operator is receiving free allocation, they also need to submit a verified annual activity level report by 31 March. A fixed deadline for submitting monitoring plans is not prescribed in legislation for stationary installations but aircraft operators are required to submit a monitoring at least 3 months before the monitoring cycle starts. Significant changes to the monitoring plan must be notified without undue delay and other changes to the monitoring plan must be notified at the latest by 31 December of each year. Most of the suggestions regarding an adjustment of deadlines related to an extension of the submission deadline of the annual activity level report. However, others also suggested delaying the deadline for significant changes to the Monitoring Plans and improvement reports. It is however noted that competent authorities may set an alternative date to the required deadline of 30 June, but no later than 30 September.
- **Harmonising EU ETS/RED/Waste Framework Directive requirements.** The ETS Directive allows that the emission factor from biomass and certain other renewable fuels[271] be set to zero. A precondition for this is that the operator must demonstrate compliance of biomass fuels with applicable greenhouse gas savings or sustainability criteria laid down in Article 29(2) to 29(7) and (10) Renewable Energy Directive.[272] Installations also have other reporting requirements under the Industrial Emissions Directive, the Waste Framework Directive and other environmental reporting regulations. Respondents to the survey expressed the need for more streamlining on the evidence needed to demonstrate compliance with the REDII criteria and for seeking more opportunities to integrate EU ETS verification and REDII audits (in terms of timelines and processes). Extending biomass certification schemes to industrial residues and waste streams was also suggested. Aircraft operators also called for simplifications in the rules to demonstrate sustainability of Sustainable Aircraft Fuels. Other suggestions for streamlining concerned the need for avoiding overlap in reporting requirements and to integrate different environmental reporting mechanisms.

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269 The risks identified in the installation and the verifier's risk analysis have an impact on the locations to be visited and the number of site visits to be carried out during the verification.

270 European Commission (2024)

271 Renewable fuels of non-biological origin, recycled carbon fuels and synthetic low carbon fuels

272 For RNFBOs and RCF the greenhouse gas savings criteria are included in Article 29a of REDII and for SLCF compliance of zero-rated synthetic low carbon fuels with the greenhouse gas emission reduction threshold as referred to in Article 2, point (13), of Directive (EU) 2024/1788 must be demonstrated. These requirements entered into force from 1 January 2025 and are therefore not included in this evaluation.

- **Relaxing requirement on monitoring accuracy.** As indicated under the section on effectiveness the MRR currently already allows operators of installations to choose between calculation-based methodologies and measurement-based methodologies.[273] Within the applicable tier approach, even installations that must meet the highest tier and the most stringent MRV requirements can deviate from those requirements in the case of unreasonable costs or technical infeasibility. Only as a last resort can a fall-back approach be applied. A key element in ensuring that the required uncertainty levels associated with the applicable tier and the overall uncertainty level of the fall-back approach is applied are uncertainty assessment. Even though the legislation and guidance already build in several simplifications, respondents to the survey suggest the need for simplified or tailored requirements for uncertainty calculations Other suggested simplifications concern the use of standard emissions factors for certain fuels, rather than requiring regular sampling of the fuel, without having to demonstrate unreasonable costs or technical infeasibility. The documentation around uncertainty assessments and risk assessment was also highlighted as causing high administrative burden.
- **Further simplifications for small installations.** The current monitoring structure already allows small installations to move to less stringent monitoring requirements. Small aircraft operators and aircraft operators having emissions of less than 3000 tonnes of CO_2 can also choose to use the Small Emitters Tool or the Eurocontrol EMIS tool which simplifies reporting and reduces verification requirements. However, some respondents felt that there could be further simplification for small installations or small sources or source streams within a larger installation.
- **More timely provision of guidance and templates and easier access to the latest version of all documents.** The Commission provides a variety of guidance, templates and tools to facilitate the process of MRVA.[274] Additionally, countries implement their own tools and procedures depending on national circumstances. Several respondents in the survey and in interviews mentioned that guidance and templates were not always provided in a timely manner, particularly not in local languages. This was said to introduce inefficiencies into the system. One suggestion was to make more use of AI for these translations. Others suggested that templates needed to be improved, without more specifics. Additionally, it was commented that it was not always easy to find the latest version of all the relevant documents so it would be useful if there was a central place that provided the links only to the most up-to-date documents.
- **More streamlining with the Industrial Emissions Directive (IED).** The IED regulates pollution from industrial production processes. Through its regulation of air pollutants, there is overlap with EU ETS for stationary installations. The ETS Directive already contains requirements for Member States to coordinate permitting procedures under the IED and the EU ETS which was implemented differently by Member States[275]. Streamlining is in some cases also taken up in the inspection procedures. In most countries the inspection is based on the inspection procedures that have been

[273] In some cases, installations are however required to apply a certain methodology: for example, installations producing nitric acid must apply continuous emission measurement according to the MRR.

[274] European Commission, Monitoring, reporting and verification, https://climate.ec.europa.eu/eu-action/carbon-markets/eu-emissions-trading-system-eu-ets/monitoring-reporting-and-verification_en

[275] In some Member States the ETS permit is part of the IED permit whereas in other Member States coordination was followed up by regular communication between IED authorities and the EU ETS competent authority or alignment with procedures.

implemented under the scope of the IED. Even though such streamlining does not always guarantee the highest environmental integrity and quality of the MRV process[276], Member States themselves have taken step to streamline procedures. It was suggested to create a single reporting platform for both the EU ETS and IED, although there was some concern that this would lead to a too complex system. Other suggestions include removing requirements to report on CO_2 under the IED, creating a single permit for pollution and EU ETS and promoting better co-ordination between the regulators for different systems.

- **Better alignment between EU ETS and CORSIA.** The Carbon Offsetting and Reduction Scheme for Internation Aviation (CORSIA) is a global market-based measure to address CO_2 emissions in aviation. Commission Delegated Regulation 2025/927 regulates that the MRR and the AVR should be applied when monitoring and reporting emissions under CORSIA thereby fully implementing the second Edition of Annex 16, Volume IV of the SARPs on CORSIA. However, some aircraft operators suggest there could be further streamlining without being specific.
- **Simplification of procedures for competent authorities and reduced timelines for approval.** The MRR requires improvement reports to be approved by the Competent Authority and the AVR obligates stationary installations that emit more than 25ktonnes of CO_2e to seek approval from the competent authority to waive a verifier's site visit. It was suggested that some of the requirements for procedures for approving improvement reports or waive of on-site visits could be simplified. It was also noted that processes for approval of the monitoring plan can be lengthy and involve a number of iterations, which adds administrative burden.

In other platforms mentioned earlier, opportunities were also raised for simplification. Some of these simplifications were already followed up in the 2023-2025 revisions of the MRR and the AVR:

- Allowing verifiers to carry out virtual site visits beyond force majeure circumstances in the ETS aviation sector where data flow is automated. The AVR was updated in 2024 to accommodate this.
- Introducing IT tools and virtual site visits in inspection approaches. Some Member States are using such approaches in inspection. A wider uptake of these good practices in the EU could help capacity problems and increase efficiency.
- Allowing more flexibility in the monitoring and reporting requirements of municipal waste incineration installations. Although this falls outside the remit of this study, the data collected could provide some insights for further tasks in this evaluation project.
- Clarifying the role of the stakeholders in using the Union Database and national databases linked to the Union Database to demonstrate compliance with sustainability and greenhouse gas savings criteria. This clarification has already been incorporated in the guidance material.
- Member States expressed a wish to streamline reporting requirements between various EU legislation to strengthen the input to UNFCCC reporting but as of yet there have not been any concrete discussions or recommendations on this.

[276] IED inspectors are not always sufficiently competent to assess the EU ETS specific monitoring aspects of the installation, and these are not always picked up in an IED inspection.

Options related to digital tools will be considered under EQ8. The other improvement options are discussed in more detail in EQ7.

- EQ6: Cost-effective application across industries and member states

This evaluation question tests whether the MRVA burden is cost efficient for all parties. For stationary installations in different sectors, the total costs reflect the complexity of the industrial processes and volume of emissions. Additional requirements for biomass reporting seem to lead to higher per unit CO_2 costs in some sectors.

In terms of size of installation, smaller installations bear relatively higher costs per unit of emissions than the larger installations, despite efforts to simplify requirements for these installations. The relative difference between the largest and smallest installations has not however increased since the previous study.

The sample size in the survey means that differences between countries can be considered between two broad groups based on GDP per capita. There are no significant differences between costs in different country groups beyond those that can be explained by differences in labour costs and distribution of installation types.

Different costs for stationary installations reflect the complexity of the industrial process and the level of emissions.

There is a large enough sample from the survey for stationary installations to analyse results by broad categories of industrial sector. Survey results indicate that installations in the chemicals, oil refining, and cement sectors generally incur costs above the average. This is likely attributable to the greater complexity of processes and/or higher emission levels typically associated with these sectors, which results in a higher number of days than average dedicated to activities. The MRVA requirements for installations in these areas account for both the complexity and scale of operations to ensure accurate emissions reporting and uphold environmental integrity. Conversely, installations in the minerals and glass, as well as pulp and paper sectors, report costs below the average but see discussion below. In a similar way to the standard cost calculation, the average EUR per tonne costs for each sector can be extrapolated to the EU level based on the number of installations in each category and the total emissions. Despite the higher per installation costs, cost per tonne of CO_2 for refining and cement sectors are on the lower side because of the higher emissions. Minerals and glass and pulp and paper report relatively high costs per tonne of CO_2. In pulp and paper, there are a high percentage of installations that use biomass (50% and 29% respectively), which adds complexity to the MRV processes. For minerals and glass, the requirements for biomass are mentioned as an issue although the percentage of installations using biomass is relatively small at the EU level (5%).[277] MRV associated with free allocation is also mentioned, but there is no clear explanation for why costs per tonne of CO_2 in this sector should be higher than others. There was no change in the allocation rules in the years 2021- 2023 (the period of the study) but the installations from the mineral and glass sector that responded could have the recent NIMS submission that was submitted in 2024 in their mind. As from 2026 installations in these sectors can also apply for allocation for recovered heat in addition to their fuel benchmarks which makes the data collection of baseline data and the annual monitoring of activity level data more complex.

[277] European Commission (2024)

The costs for installations below 25kt range from 3-7 EUR per tonne of CO_2, while for the largest installations the range is 0.1-0.4 EUR per tonne of CO_2. This cost differential was also found in the 2016 report on administrative costs, with Category A installations facing costs per tonne CO_2 around 50 times that of Category C.[278] In the current study, the difference between these two categories is about the same. As discussed previously, over the years several measures were taken to simplify the monitoring requirements for the smaller installations whilst ensuring the environmental integrity and robustness of monitoring and reporting. Nevertheless, smaller installations still report higher costs.

Stationary installations

To investigate the distribution of costs by country, each country was classified into one of two groups based on GDP per capita. Group I consists of countries with an average GDP per capita above EUR 37,000, while Group II includes those below this threshold. Installations in Group I countries report higher average costs particularly for equipment costs. Conversely, in terms of days, stationary installations in Group II countries report using more days on MRV activities, particularly so for verification. The difference in costs can be partially attributed to higher labour costs in Group I countries. On average the labour costs within Group I countries are 2.5 times those in Group II. The cost differences are mostly within this range.

Additionally, a larger proportion of the biggest installations responding to the survey are located within Group I countries. As these generally have higher costs associated with MRVA, the distribution of installation types between countries has an impact on average cost in a country. Although a few respondents noted variations in the implementation of MRVA requirements between countries, these differences were generally mentioned as being between member states within the same group. Overall, there is limited evidence to suggest that geographical differences, beyond those explained by labour costs and the distribution of installation types, play a significant role in cost variation. This finding echoes the finding from the 2016 administrative cost study.[279]

Competent authorities

For competent authorities, both the costs and the number of days are greater in Group I countries than in Group II countries. The difference in costs is within the range of differences in labour costs. The difference in number of days is significant. As discussed above, one factor is the type of installations present in a country, and another is the total number of installations. On average, Group I countries administer around twice the number of stationary installations than Group II installations, although there is also significant variation between countries within the groups. The differences are reflected in the number of staff employed by the competent authority particularly for stationary installations with Group I countries employing nearly three times the number compared to Group II countries.

Another factor that can determine costs is the organisation of the administration within a country. As mentioned in the *"Effectiveness"* section, 19 countries currently have a centralised organisation, with other countries have a more decentralised organisation in the form of multiple regional competent authorities. For aviation, many countries have assigned different competent authorities for MRV activities to those for the management of stationary installations. Where multiple competent authorities are involved in EU ETS activities,

[278] Evaluation of EU ETS Monitoring, Reporting and Verification Administration Costs, 2016
[279] Ibid

additional activities are needed to coordinate to ensure harmonised application of the rules. Such coordination is required in Article 10 of the MRR.[280] Internally within a competent authority there will also be differences in the type of resources implemented by the competent authority, size of staff and number of installations or aircraft operators are managed by a competent authority.

- EQ7: Opportunities to streamline or simplify the MRVA

This evaluation question builds on EQ5 to examine whether there is evidence of opportunities to streamline and/or simplify the MRVA system to increase cost efficiency.

Based on a **qualitative assessment of options for simplification** that were suggested by participants in the survey and proposals that were brought forward in the OPC, no options stand out as priorities for regulatory change within EU ETS because these could have a negative impact on the environmental integrity of the ETS system or because they have already been addressed by legislative changes in 2024 and 2025. However, some need more consideration. These include:

- Simplifications in the requirements for installations emitting less than 50 kt CO_2 with very simple monitoring methodologies and low inherent and control risks. Most simplifications are already accommodated in the MRR and low risks in simple and small installation often require less extensive verification approaches. Examples in training events could highlight how to deal with these simplifications.
- Simplification of requirements for uncertainty for smaller source streams and allowing a wider application of default values for the emission factors and calorific value for certain fuels. Generally, the current MRR already allows simplification on uncertainty assessment and the application of default values for commercially standard fuels. However, further research may reveal additional opportunities for simplification.
- Further streamlining procedures or reporting requirements between IED, EU ETS and other legislation, in particular to avoid overlap in reporting data.
- Simplification through digitalisation (see under EQ8).

As mentioned under EQ5, other simplifications were raised in other fora of stakeholders. Some of these issues are not necessarily related to the 2021-2023 evaluation and are either being assessed in other studies. These include:

- Simplification for municipal waste incineration installation as these currently have difficulty meeting the required tiers.
- Simplification of biomass requirements to demonstrate compliance with REDII criteria.
- Simplification of requirements on alternative fuels and eligible aviation fuels in the aviation sectors.
- EQ8: Role of technology in improving the efficiency the MRVA

Evaluation question 8 examines the evidence regarding the role of technology in implementing the MRVA system and whether there are opportunities to increase its use.

Experience to date suggests both efficiency and accuracy of MRVA can be improved by the implementation of digital tools. Additional to the current use, there are further options to incentivise used of digital tools to improve efficiency. Barriers to digitalisation noted in the

[280] European Commission (2024)

reality check workshop were non-standardised key inputs such as supplier data and laboratory methods and the frequent changes to templates and requirements noted earlier.

There are also emerging technologies that can be used for different components of MRVA. These include amongst others the Internet of Things (IoT), AI and Machine Learning and Blockchains. The role of regulation in this case would be to enable their use where it can improve efficiency, while maintaining environmental effectiveness.

Various tools have been developed and implemented to help improve efficiency of the MRVA system and increase the accuracy of reported data. The 2016 administrative cost study reported efficiency gains for competent authorities from the use of electronic reporting. Reporting under Article 21 of the ETS Directive gives more up to date information on their use.

Templates have been developed by the European Commission for monitoring plans, emission reports, verification reports and improvement reports (for installations and aviation).[281] In 2022, 25 countries reported using the Commission templates.

The ETS Reporting Tool

Additionally, the European Commission has developed an IT tool called ETS Reporting Tool MRV (ERT), designed to facilitate the submission of monitoring plans, emission reports, verification reports, and improvement reports. This tool helps streamline reporting to reduce administrative burden and improve the reporting accuracy and increase compliance of installations. The ERT is a web-based platform offering advanced features for all stakeholders and applies to sectors covered by the EU ETS.[282] The Commission conducted a survey of competent authorities in 2022 on the use of ERT. Some positive points identified included that changes in templates were immediately and directly accessible in the application, and that aggregated data and reports offer good visibility of the stored reports. The survey and issues raised at the Helpdesk has resulted in some improvements. Respondents also asked for training, which was provided.

According to the Article 21 report, 18 countries (or in some cases only some regions in a country) reported using an IT system to manage the MRV workflow between competent authorities, stationary installation and aircraft operators, and verifiers. This includes a slight increase in the number of countries using ERT. The type of national IT systems that other countries have developed themselves vary between countries in terms of scope, access, functionalities and origin. In some countries simple workflow systems are used, while in other countries integrated reporting systems exist providing access to all parties, including advanced functionalities and managing all steps in the compliance cycle.

In the survey, around half of the CAs responding have implemented the ERT. Of those, more than half reported that it had improved efficiency and quality of reporting significantly or slightly. Fewer CAs in the survey reported having developed their own IT system but those that had, reported that it had improved efficiency.

In general, countries with the highest number of installations have implemented either national IT systems or are using Commission templates. Some of the countries having developed national IT systems, have expressed interest in linking their national systems to ERT. Currently, there are some technical limitations particularly round security that prevent this, but

[281] European Commission, Monitoring, reporting, and verification, https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/monitoring-reporting-and-verification-eu-ets-emissions_en#tab-0-1

[282] Ibid

solutions are being pursued. These solutions would allow at least sharing of files that need to be submitted to the Commission such as allocation data[283] which would increase efficiency. Another request from countries, who have started or plan to start using ERT, is to allow historical MRVA records to be imported. [284]

A barrier to entry for some countries with limited resources is that they need to onboard their users to the ERT system i.e. they need to invite installations to use the system and provide appropriate guidance. The Commission has some training sessions recorded that can be used for this purpose, but there still needs to be resources committed by the competent authorities. By expanding the functionalities of ERT, the use of ERT has increased in more recent years (e.g. data can be automatically extracted from the system for the purpose of Article 21 reporting).

ERT has furthermore been updated to include the **relevant processes and forms for ETS2**, which has encouraged more use, although some countries only use it for that purpose. The functionality of ERT would also allow it to be used for other reporting processes for example there are currently discussions on using it for CCS reporting.

Most verifiers in the survey reported using either ERT or a national IT tool (equally split between the two). Around half reported this as having increased efficiency, with the rest reporting no change.

The Compliance Cycle Evaluation Study in 2018 and Analysis of Article 21 responses in addition to the analysis of the survey responses show that opportunities to improve the effectiveness of the IT tools mostly exist in:

- building in harmonised checklists in the monitoring plan approval process and incorporating those in the IT systems. Some Member States have developed good practices that have improved the coordination of this process.
- automated functionalities in the IT system to facilitate the approval process and the notification of changes to the monitoring plan, e.g. automated completeness and consistency checks in the system, automated reminders for submission deadlines, alerts if incomplete or implausible data is inserted in the system
- incentivising more Member States to use the ERT.

There are also emerging technologies that can be used for different components of MRVA. These include amongst others the Internet of Things (IoT), AI and Machine Learning and Blockchains.[285,286,287] Case studies outside the EU ETS have found that they can reduce administrative burden and effectiveness, although economic efficiency depends on scale of implementation.[288] Although these technologies could potentially be useful, because of their

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283 Documents as part of the National Implementation Measures (NIMS) procedures in accordance with Article 11 of the EU ETS Directive

284 Interview 4th Nov 2025

285 Mungroo et al, 2024. "Addressing leakage in mechanism methodologies", https://unfccc.int/sites/default/files/resource/MEP004_CfI_Addressing_Leakage_Mungroo.pdf

286 TERI, 2025. "Report on international practices on MRV for steel value chain", https://www.sameeeksha.org/pdf/publications/MRV%20Report_final%2018.08.2025.pdf

287 TBI, 2025. "International Carbon Markets: Climate Action at a Lower Price", https://institute.global/insights/climate-and-energy/international-carbon-markets-climate-action-at-a-lower-price

288 Gold Standard, 2024. "MRV Report on Pilot Projects, Roadmap and Resources", https://www.goldstandard.org/publications/mrv-report-on-pilot-projects-roadmap-and-resources

nature implementation would largely be a commercial decision for installations and aircraft operators. Within the aviation sector such automated systems are more common than in the industry sector and have been used more widely to manage aircraft data.

The role of MRVA regulations would be to enable the use of these technologies where it can be demonstrated that they provide the necessary level of accuracy. No respondents have highlighted that there are regulatory barriers to their use. It is recommended to monitor the operator's or aircraft operator's use of these new technologies as this can improve not only the accuracy of emissions but also effectiveness and efficiency of the monitoring processes.

The Compliance Forum can be a platform where competent authorities share information on new technologies that are used in monitoring and technologies that are applied in their own review and inspection processes. Experiences can for example be shared on how some ***competent authorities use virtual site visits with advanced technologies*** to inspect installations[289] or use automated tools to facilitate the review of emission reports of select installations to be inspected. In some Task Forces external speakers are sometimes invited for a presentation to share good practices or present a study or case study. It could have added value to learn about the use of these new technologies and practices in third countries.[290]

With respect to verification of stationary installation's emission reports it may have added value to assess whether virtual site visits by verifier could be allowed beyond force majeure circumstances under very strict conditions. Technologies are improving and may allow an effective virtual site visit provided certain conditions have been met. Care should however be taken that the quality of verification will not be hampered by this. Physical site visits are an instrumental part of the verification as it enables the verifier to inspect metering equipment, interview staff and to properly assess the accounting boundaries.

Despite the already established use of digital tools, many of the respondents suggested MRVA could be made more efficient and administrative burden reduced if there were more, and more harmonised, tools available. From the analysis for EQ7, several options can be distinguished to incentivise the use of ERT or further IT systems:

Option 1 - Mandate the use of ERT

Under this option Article 74 and 75 of the MRR would be amended to require Member States and stakeholders to use ERT for the submission of monitoring plans, emission reports, verification reports and improvement reports. The advantage of the option that it would further harmonise procedures between Member States and improve the effectiveness of MRV processes for all stakeholders involved. All Member States would use the same system with similar functionalities and automated checks and the transmission of information to the Commission (e.g. NIMS data collection, reports of municipal waste incineration installations, other relevant information that needs to be submitted to the Commission by law). The disadvantages of this option include the risk of infringing the subsidiarity principle for Member States to set-up national administrative procedures and tools and the additional resources needed to onboard users to the ERT system and adapt it to national procedures. Resistance from countries that have already implemented an IT system and invested in their own systems might

[289] In Ireland virtual site visits were carried out to inspect certain installations. Germany uses automated tools to review emissions reports and select installations to be inspected.

[290] In the TF CCS ICAP and the Global CCS Institute provided presentations on the use of CCS and CCU technologies across the world.

be mitigated by mandating Member States to use ERT unless they have implemented a national IT system of equivalent nature.

Option 2 - Leave Member States the option to use ERT and continue with efforts to enable linking of national MRVA systems

Under this option Article 75 and 75 of the MRR would not be changed and Member States would be left the option to use ERT or their own national systems, but the European Commission would undertake measures enabling linking of national IT systems to the ERT. This would facilitate the submission of information to the Commission. The disadvantage of this option is that Member States would be allowed to implement different systems or to not use IT systems so the differences in tools and procedures would continue to exist. Links could have risks to confidentiality and security of data and might cause some resistance from Member States or stakeholders in that Member States. This risk could be mitigated by implementing safeguards in the system to ensure confidentiality and security of data.

Option 3 - Leave Member States the option to use ERT and to continue to improve ERT

This option would have similar consequences to option 2. No amendment would be necessary in the MRR and in principle the options could be applied in combination. Opportunities to improve the ERT could include the following: (1)Continue with efforts to allow import of historical records into ERT; (2)Explore ways to link ERT with other reporting systems such as for other environmental reporting mechanisms; (3)Improve other functionalities in the system such as building in certain automated checks; (4)Provide NABs access to the system so that the information exchange between NAB and competent authorities can take place through the ERT. This could standardise and facilitate the information exchange even further.

As with option 2 differences of MS practices and IT systems would still exist if the use of ERT is only on a voluntary basis. Further analysis of the above options could have added value. If no action is taken or only option 2 and 3 is feasible it may be worthwhile considering adapting Article 74 of the MRR and require stakeholders to use the Commission templates unless a Member State has required stakeholders to use a national template or national IT system that contains at least the same information as the Commission template. Although most Member States either have an IT system or prescribe Commission templates, in some countries the use of Commission or national templates is not prescribed as national law prevents them from mandating the use of templates. This has caused differences between stakeholders and caused complications in the implementation. As this only applies for a few Member States, the problem is not significant, but it is still a barrier for EU wide harmonisation on this area.

8.4.5 Conclusions

The evaluation of the EU ETS MRVA system underscores the effectiveness in ensuring accurate, complete, and transparent greenhouse gas emissions data, reinforcing methodological consistency across Member States. Methodological consistency remains very high, with calculation-based monitoring applied to nearly all stationary installations and fall-back approaches limited to less than 1% of cases. In terms of accuracy and completeness, conservative estimates remain below 1 % of total verified emissions, and submissions of verified emission reports that are missed account for only 1–1.5 % of all installations. Negative verification opinions (≈ 30 per year) and report rejections (≈ 50) are rare, while penalties affect just 0.5 % of operators. Overall, the MRVA framework functions as a mature and harmonised system, delivering highly reliable, comparable, and comprehensive greenhouse-gas data across all Member States and sectors.

Together, the evidence also shows a **mature and well-functioning system** that consistently upholds data integrity. NABs effectively supervise verifiers carrying out annual surveillance by conducting office audits, document review and witness audits of verifier's actual performance in the verification, with a majority reporting no deterioration in their risk-based surveillance. Verifications and on-site visits are done with a high consistency and quality. Although reported discrepancies remain low, one Member State[291] stands out as a statistical outlier, contributing a disproportionate share of misstatements and non-conformities, which may indicate country-specific issues. Trust in the system remains high, but concerns over tightening verifier capacity, especially with upcoming reporting obligations, highlight potential challenges for the future.

Overall, Member States have maintained a high level of **procedural maturity in implementing MRVA processes under Phase IV**, with improvements that are incremental rather than transformative. Coordination between competent authorities, NABs, and other agencies remains well established and effective, supported by EU-level guidance used by nearly all competent authorities. Internal organisation has largely stabilised. Nineteen countries operate with more centralised approaches, while twelve maintain decentralised systems but have strengthened coordination through working groups, regular meetings, a central competent authority overseeing operations and shared training. These arrangements ensure consistency while accommodating national administrative diversity. Permitting, monitoring, and review procedures also show sustained quality, reinforced by digitalisation and standardised templates. Around one-third of competent authorities reported procedural enhancements, often related to digital tools or integration of external datasets. Inspection and enforcement practices remained regular and risk-based, with modest efficiency gains. Collectively, these findings indicate that procedural adjustments by Member States have strengthened administrative efficiency and harmonisation, thereby sustaining high compliance assurance within the MRVA system, though perceived simplification by operators remains limited.

The EU ETS MRVA framework remains legally solid and operationally robust, with the 2018 MRR and AVR effectively integrated across Member States and no MRVA-related infringement cases. Subsequent amendments between 2020 and 2022 enhanced adaptability, ensuring verification continuity during COVID-19, as well as aligning with RED II and CORSIA. However, new challenges are emerging as the system expands to the scope (including maritime transport), exposing coordination and readiness gaps. Stakeholders also report limited simplification and delays in regulatory updates, particularly on free allocation. Overall, while the MRVA system ensures compliance integrity, further improvements could be beneficial to enhance timeliness and proportionate simplification in future phases.

Although the MRVA system has achieved its objectives cost-efficiently, concerns persist regarding administrative costs. Costs associated with MRVA are identified as an issue by both stationary installations and aircraft operators but for most still represent a relatively small proportion of the compliance costs for the EU ETS. Evidence is slightly contradictory about differences in annual costs between Phase III and Phase IV of the EU ETS, with opinions suggesting limited changes but the reported costs being higher than previous estimates. Where larger changes are flagged it is often associated with MRVA for free allocation. Drafting a monitoring plan and establishing the control system are the biggest components of one-off costs for stationary installations and for aircraft operators it is purchase of equipment.

[291] France

Evidence for cost effective application across different stakeholders is similar to previous studies. For stationary installations in different sectors, the total costs reflect the complexity of the industrial processes and volume of emissions. Additional requirements for biomass reporting seem to lead to higher per unit CO_2 costs in some sectors. In terms of size of installation, smaller installations bear relatively higher costs per unit of emissions than the larger installations, despite efforts to simplify requirements for these installations. The relative difference between the largest and smallest installations has not however increased since the previous study. The sample size in the survey means that differences between countries can be considered between two broad groups based on GDP per capita. There are no significant differences between costs in different country groups beyond those that can be explained by differences in labour costs and distribution of installation types.

The MRVA system has already been streamlined and simplified as it developed, motivated by increasing cost efficiency but also improving equal treatment. No significant opportunities to streamline or simplify the system have yet been identified in the evidence, but there are options that might provide incremental efficiency gains. While potentially providing some efficiencies, many of the options have implications for environmental effectiveness or legal/practical implications that need more consideration. Both survey and consultation results from the ETS and MSR evaluation indicate that Phase IV reforms strengthened traceability and consistency, but stakeholders felt that it did not totally deliver on simplification, leaving administrative burden a key concern for future MRVA improvements.

Experience to date suggests both efficiency and accuracy of MRVA can be improved by the implementation of digital tools, such as the Commission reporting tool ERT. Additional to the current use, there are further options to incentivise used of digital tools to improve efficiency. There are also emerging technologies that can be used for different components of MRVA. These include amongst others the Internet of Things (IoT), AI and Machine Learning and Blockchains. The role of regulation in this case would be to enable their use where it can improve efficiency, while maintaining environmental effectiveness.

Overall, the findings indicate that the EU ETS MRVA system functions as a mature and harmonised framework. While incremental improvements have been noted, ongoing evaluations and strategic investments in technology and simplification initiatives are vital to enhance both effectiveness and efficiency, ensuring sustainable environmental compliance across the EU.

8.5 The Monitoring, Reporting and Verification (MRV) Maritime Regulation

8.5.1 Introduction

The MRV Maritime Regulation (EU) 2015/757 established a system for the monitoring, reporting and verification of greenhouse gas emissions based on the fuel consumption of ships (MRV maritime system) as a first step of a staged approach for the inclusion of maritime transport emissions in the EU ETS.

This evaluation analyses the role of the MRV maritime system concerning its policy objectives of supporting shipping decarbonisation, by establishing a robust and transparent reporting system for greenhouse gas emissions and supporting the ETS extension to the sector. The evaluation covers the entire period since the application (2018) of the MRV Maritime Regulation and takes into due account the recent (2023) revision of the system, to the extent relevant to the MRV scope and in a manner compatible with the limited evidence and experience of its implementation, which only started in the reporting period 2024. This evaluation builds on a dedicated support study of which finalisation is still ongoing at the time of writing, and of which publication is expected in 2026[292].

Regulation (EU) 2015/757 was limited to ships of 5,000 GT and above in respect of the carbon dioxide emissions released during their voyages from or/and the EEA for transporting for commercial purposes cargo or passengers. The amendments introduced by Regulation (EU) 2023/957 provided for the inclusion of maritime transport activities in the EU ETS. The main changes to the MRV system brought by the 2023 revision are illustrated in the following table:

Table 14: Key changes to the MRV system introduced with the 2023 revision (amending Regulation (EU) 2023/957)

Issue	Key changes introduced
Scope of greenhouse gases	Expansion of monitored gases beyond CO_2: from 1 January 2024, both methane (CH_4) and nitrous oxide (N_2O) must be monitored and reported. Monitoring methods and parameter rules updated through Delegated Regulation 2023/2776
Ships under scope	From 1 January 2025, the scope extends to general cargo ships of 400 GT and above (but below 5,000 GT) and offshore ships of 400 GT and above.
Company and fleet-level reporting and partial reports	From 2025, verified aggregated emissions data at company (fleet) level must also be submitted annually, together with ship-level emissions, using a standardised electronic template. Introduction of "partial emissions reports" in case of change of company during a reporting period: the prior company must submit a verified partial emissions report covering its period of responsibility.

[292] RICARDO, 2026, Support study for the evaluation of the EU Maritime MRV system in the context of the ETS Directive review (forthcoming).

Monitoring plans/submission deadlines/ administration	New and updated templates and electronic formats adopted through Implementing Regulation (EU) 2023/2449 to capture CH_4/N_2O, company-level aggregates and new data requirements. Deadline: by 1 April 2024 (or within three months after first EEA port call) companies to submit verified monitoring plans under the amended rules. The administering authority (Member State authority responsible for ETS administration) is introduced in the MRV/ETS compliance cycle.

8.5.2 Point of comparison

The evaluation of the MRV maritime system is based on the provisions of the ETS Directive, the MRV maritime Regulation, and its related implementing regulations. The key legal provisions of the ETS Directive relevant to the MRV maritime are:

Article 3gd: Monitoring and reporting of emissions from maritime transport. Requires shipping companies to monitor and report relevant parameters and aggregate emissions data at company level in accordance with the MRV maritime system.

Article 3ge: Verification and accreditation rules for emissions from maritime transport. Requires that emissions reports be verified by accredited independent verifiers in accordance with the verification and accreditation rules set in the MRV maritime Regulation.

Article 3gf: Administering authority in respect of a shipping company. Outlines the role of administering authorities in respect of shipping companies, including with respect to the attribution mechanism.

The key provisions outlining the principles of the MRV maritime system as in Regulation (EU) 2015/757 are:

Article 6: Content and submission of the monitoring plan. Requires companies to establish a monitoring plan and outlines its main elements.

Article 8: Monitoring of activities within a reporting period. Requires companies to carry out the monitoring of relevant parameters on the basis of the monitoring plan.

Article 11: Content of the emissions report. Establish the obligation for companies to submit verified emissions reports and outlines the information to be contained therein.

Article 13 Scope of verification activities and verification report. Outlines the verifier's role in respect of the different elements of the MRV compliance cycle and provides the legal basis for the Delegated Regulation on Accreditation and Verification for MRV maritime.

Article 20: Penalties, information exchange and expulsion order. Establishes the enforcement regime for non-compliance in respect of MRV maritime obligations.

Delegated and implementing acts have also been adopted by the Commission to operationalise the MRV Maritime framework. These include:

Commission Delegated Regulation (EU) 2023/2776 that amended the rules for monitoring greenhouse gas emissions and other relevant information

Commission Delegated Regulation (EU) 2023/2917 that replaced Delegated Regulation (EU) 2016/2072 covering verification activities, accreditation of verifiers and approval of monitoring plans by administering authorities

Implementing Regulation (EU) 2023/2449 that repealed Implementing Regulation (EU) 2016/1927 providing templates to be used for monitoring plans, emission reports and Documents of Compliance

Implementing Regulation (EU) 2016/1928 providing the rules to determine cargo carried for certain ship categories

Following the adoption of Regulation (EU) 2023/957, a further amendment was adopted in late 2024 through Commission Delegated Regulation (EU) 2024/3214 to clarify MRV application to offshore activities and the zero-rating of sustainable fuels.

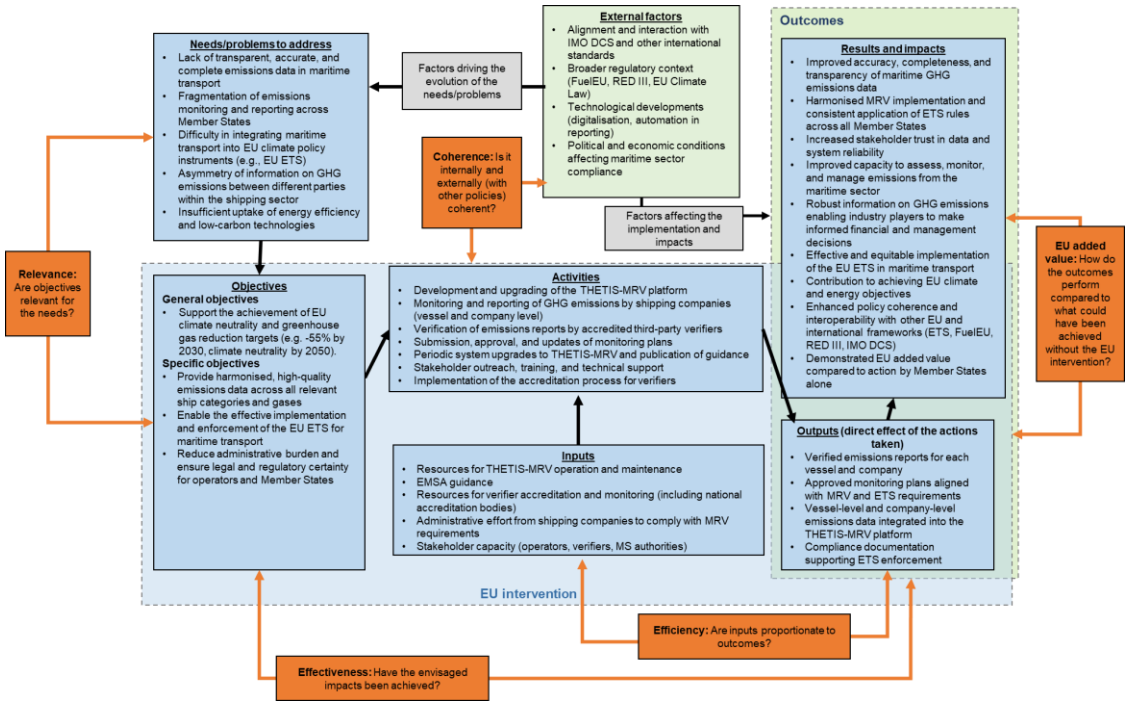
Because of the 2023 revision of the Regulation, guidance and templates were developed and updated in relevant expert groups to ensure a harmonised interpretation of the new requirements.

8.5.3 Intervention logic

The below figure provides a structured representation of how different actors and actions have been interacting under the EU maritime MRV system and how they contribute to deliver on the general and specific objectives of the system. It sets out the causal chain linking inputs, activities, outputs, results, and impacts, while identifying the assumptions underpinning each stage.

The objectives, needs and problems identified in the diagram reflect the issues the MRV Regulation was designed to address. The intervention logic has therefore been developed drawing on the relevant legislation as well as on the 2013 Impact Assessment supporting the 2015 MRV Regulation, and the Commission's 2021 Impact Assessment for the inclusion of maritime transport in the ETS.

Figure 32: Intervention logic diagram (MRV Maritime system)



Source: Own illustration

8.5.3.1 Problem to address

The MRV Maritime system was established to collect transparent, accurate and complete data on greenhouse gas emissions and energy efficiency from maritime transport activities. Before the implementation of the system, few Member States had piloted partial or sector-specific initiatives to monitor and report shipping emissions, resulting in a fragmented scenario, unfit to support the integration of the sector into EU climate policy instruments and causing an asymmetry of information between different actors within the shipping industry, thus hindering the uptake of energy efficiency and low-carbon technologies.

8.5.3.2 Objectives

The general objective of the MRV maritime system is to support EU climate neutrality by 2050 and greenhouse gas reduction targets, as set in the EU Climate Law and the Fit for 55 legislation to deliver the European Green Deal. To deliver this, the system pursues three specific objectives. The first one is to establish and maintain a harmonised emissions data system applicable to all relevant ship categories, activities, and greenhouse gases. The second specific objective of the system is to enable the effective implementation of the EU ETS application to maritime transport activities. The third specific objective of the system is to ensure legal and regulatory certainty for involved actors, while reducing administrative burden.

8.5.3.3 Inputs

The successful implementation and enhancement of the MRV maritime framework is expected to rely on several key inputs allocated by different actors, both at national and EU level: collaboration and support from relevant Commission services and the European Maritime Safety Agency (EMSA) to provide the necessary support to implementation, administrative and financial support to maintain in operation the mandatory IT system for compliance (THETIS-MRV), resources from actors involved in the verification and accreditation system (accredited verifiers and National Accreditation Bodies - NABs) to ensure the quality of verification activities, adequate technical, financial, and administrative capacity by the actors required to administer and implementing the system (shipping companies, verifiers, Administering Authorities of Member State).

8.5.3.4 Actions

Relevant actors affected by the establishment of the MRV system are expected to be undertaking different activities, depending on their role in the MRV compliance cycle stemming from the respective legislative requirements. The European Commission Services and EMSA provide the necessary support to stakeholders, through guidance and maintenance of relevant technical tools for implementation. Operators collect and aggregate the data required under the system, producing reports for submission on the basis of monitoring plans. Verifiers and NABs provide respectively verification and accreditation services. Member State authorities are responsible for the implementation of the system in respect of the companies under their responsibility, including through exchange of information with NABs to ensure quality of verification, and further complement the support to implementation provided by EMSA.

8.5.3.5 Output

Because of the implementation of the system, different outputs are expected in the short term by relevant stakeholders. European Commission services and EMSA deliver guidance, provide

support to implementation, and maintain the technical tools necessary for compliance (e.g. THETIS-MRV). Accredited verifiers deliver third party verification on the relevant outputs by shipping companies and NABs carry out surveillance activities to ensure the robustness of the verification framework under which accredited verifiers operate. After establishing and implementing monitoring methods in accordance with MRV requirements, shipping companies submit relevant emissions data. Member State authorities administer the system, ensuring compliance checks on key deliverables and imposing enforcement measures.

8.5.3.6 Intended results and impacts

The expected effects of the intervention in the medium and long term include the implementation of a coherent MRV system by shipping companies, thus supporting the accuracy, completeness, and transparency of reported greenhouse gas emissions and energy efficiency data from maritime transport activities. The harmonised implementation across different EU Member State is expected to increase stakeholders' trust in the system's reliability in collecting energy and emissions performance data, while serving as a necessary element for the robust implementation of the ETS extension to shipping.

The reliance on robust, complete and transparent data is further expected to enable industry players to better understand emissions data and behaviours, thus making informed financial and management decisions on their operations to ultimately better contribute to the uptake of decarbonisation technologies to support the EU policy objective of shipping decarbonisation. Also, regulators and national authorities are expected to increasingly rely on robust and complete emissions data as reported under the MRV maritime system, to design regulatory measures to further support shipping decarbonisation, while enhancing coherence and interoperability with other relevant frameworks.

8.5.3.7 Unintended results and impacts

The implementation of the MRV Regulation may potentially lead to unintended effects in the form of increased complexity and administrative costs, in particular as a consequence of the 2023 revision to prepare for the extension of ETS to maritime. A further concern stems from the potential for duplications or inconsistencies in reporting requirements established by other regulatory measures affecting the sector, within and outside the EU.

8.5.3.8 External factors

External factors relevant to the MRV maritime system include the interactions with international regulations establishing data collection and reporting for the purpose of shipping decarbonisation and potentially covering the same regulated entities and/or activities, such as the Data Collection System (IMO DCS) established under the International Maritime Organisation (IMO). The pace and depth of the uptake of technological solutions to implement MRV system (e.g. digitisation) may further affect the intervention, as well as any general major political and economic event affecting the shipping sector's ability to comply.

8.5.3.9 EU/national policies

The MRV maritime system works in the context of the broader EU climate policy, one of its main objectives being to support the implementation of the EU ETS system insofar maritime transport activities. In addition to this, the system operates within a complex policy environment, at the intersection of climate action, transport, energy, and innovation policy. A number of emerging and evolving policy instruments are introducing new climate-related reporting obligations that potentially interacted with, or overlap, the requirements of the MRV system for maritime. These notably include some of the key elements to support shipping

decarbonisation under the ‘Fit for 55’ package, such as the FuelEU maritime Regulation and the revision of the Renewable Energy Directive.

8.5.3.10 Data collection

The evaluation findings rely on several data sources, which include:

- legislative and policy documents (e.g. primary and secondary legal acts).
- available impact assessment and evaluations carried out by the European Commission on MRV and ETS maritime.
- any relevant studies, guidance, and information material on MRV and ETS system for maritime produced by the European Commission or the European Maritime Safety Agency.
- research and academic studies on MRV systems and shipping decarbonisation.
- quantitative datasets.

Desk research activity was combined with an online survey which collected 152 complete questionnaires from shipping companies, verifiers, NABs, and Member State authorities. Follow-up interviews were conducted with selected stakeholders to gain deeper understanding of selected issues raised in the survey.

8.5.4 Evaluation findings

8.5.4.1 Effectiveness

The effectiveness criterion evaluates how successfully the MRV maritime system has fulfilled its objectives of ensuring that greenhouse gas and energy efficiency data reported by shipping companies are accurate, complete and transparent, in compliance with the requirements of Regulation (EU) 2015/757, as amended in 2023. To this end, the analysis of this criterion examines whether the procedures, digital infrastructure, and governance mechanisms put in place covering monitoring, verification, reporting, and publication, have effectively prevented errors, misreporting and inconsistencies, thereby ensuring the reliability of the data used for policy and compliance purposes. This criterion is developed through three evaluation questions related to the effectiveness of the monitoring and reporting system, as well as that of the verification and accreditation framework, and to the ability of the system to respond to new challenges.

- EQ1: To what extent has the MRV maritime system ensured the accuracy, completeness, and transparency of greenhouse gas emissions data, and has it effectively prevented errors and misreporting?

To answer this question, the analysis was developed in respect of three main data dimensions: relevant procedures and control mechanisms in place under the system, the observed results and quality trends, and the transparency and accessibility of MRV data. The analysis draws on quantitative indicators, as collected through THETIS-MRV, survey evidence, follow-up interviews with stakeholders, and desk research activity.

Evidence shows that the MRV maritime system has substantially strengthened the accuracy, completeness and transparency of greenhouse gas emissions data. is the MRV system can rely on a multi-step and multi-actor compliance system based on harmonised monitoring plans, standardised monitoring and calculations methods (for fuel consumption, emissions, and other relevant parameters), risk-based accredited verification, administering authority checks, and public disclosure. These elements have contributed to a marked improvement in the quality of

reported data: the number of outliers as in verified submissions considerably declined since the first reporting period (i.e. 2018), with remaining anomalies generally not impacting emissions data, yet still showing some residual data quality issues.

On completeness, coverage is robust for the fleet above 5 000 gross tonnage and main emitting ship types and routes, capturing roughly 87% of CO_2 from EEA-related traffic. Smaller vessels, some specific ship types (e.g. the type of LNG carrier, the type "other ships"), and newly added methane and nitrous oxide reporting requirements, were found to present higher incompleteness risk, in particular due to knowledge and capacity constraints among small and first-time operators in the first reporting year after the 2023 revision (i.e. 2024). These, however, are expected to be temporary issues.

The MRV system guarantees access to transparent and easy-to-read data to the wider public. Verified ship-level datasets and MRV aggregate annual reports are openly available, technically reliable, and widely used by regulators, researchers and market actors. Still, some users indicate potential improvements in the IT infrastructure to enhance their ability to access and use available data. Verifiers and authorities supported additional download or filtering functionalities, and the general public highlighted the need to manually detect, remove or correct residual obvious errors (i.e. outliers) in the extracts before the data can be further exploited for further analytical purposes. Furthermore, non-disclosure of some additional datapoints at ship level (e.g. ship's technical efficiency values, tonnage, IMO carbon intensity indicator, or fuel consumption differentiated by fuel type) could further help researchers to fully exploit the potential of published datasets.

There is currently no evidence of widespread deliberate misreporting or falsification of reported data, and enforcement and verification rules are in place to avoid it, but data on issued sanctions and key quality-related performance indicators (e.g. verification outcomes, monitoring plan approval rates, type and frequency of corrections) are not made public nor systematically reported yet , thus limiting the ability to fully assess system performance.

Overall, the MRV framework has proved to be effective and credible in ensuring the accuracy, completeness, and transparency of the reported data for the main regulated fleet and activity parameters. The procedures and governance infrastructure of the system proved capable of detecting and minimizing the risk of errors and misreporting. The 2023 revision determined an increased in the complexity of reporting requirements, including the inclusion of new fleet segments and new greenhouse gases (i.e. methane and nitrous oxide) under the scope, which presented new challenges for the completeness and quality of the reported data. This is expected to require closer compliance monitoring to fully assess the MRV robustness across all elements of the system in the next reporting periods.

- EQ2: Has the verification and accreditation system been successful in delivering robust implementation of the MRV and ETS system for maritime?

EQ2 assesses how effectively the verification and accreditation framework established under the MRV Regulation ensured the successful implementation of the overall MRV and ETS system for maritime, by providing confidence on the accuracy of reported emissions data. It draws primarily on stakeholder survey findings, supplemented by evidence from desk research.

Together, these sources confirm that the MRV maritime framework can rely on a mature and well-functioning system that consistently upholds data integrity. Verifiers and NABs generally fulfil their expected roles, ensuring compliance and data accuracy through rigorous, harmonised methodologies aligned with EU-wide standards. A comprehensive accreditation framework, supported by structured audit cycles ensures the accuracy, consistency and

credibility of emissions data underpinned by clearly defined roles for verifiers and NABs. The EU-wide alignment of accreditation standards and processes have ensured a baseline level of competence and independence for the different verifiers active under the scope, irrespective of the Member State where they operate. These features have collectively established a credible and functionally robust system that contributes significantly to the accuracy, consistency and credibility of emissions data.

However, the evidence also suggests that this robustness may potentially be constrained by some limitations. Verification capacity remains concentrated among a limited number of providers, which could lead to bottlenecks and delays in verification works. Both authorities and shipping companies have flagged a lack of responsiveness or poor communication by some verifiers, and authorities noted some variability in the quality of the verification services provided across accredited verifiers. Both these elements, if properly addressed, could contribute to improve stakeholders' confidence in the verification system.

While oversight through accreditation appears overall robust, the analysis conducted under this evaluation could not find wide evidence to ascertain in detail how NABs implement conflict-of-interest checks, corrective actions, and information exchange mechanisms, which could potentially hide cases of uneven enforcement.

Overall, while the verification and accreditation system has successfully supported the implementation of the MRV system so far, the 2023 revision has been presenting new challenges in the verification pillar of the system. Strengthening verifiers capacity and enhancing coordination between verifiers, NABs and Member State Authorities, are two key elements which could further reinforce the system's credibility, transparency and effectiveness in the long term.

- EQ3: How well has the MRV maritime system adapted to new challenges, such as the inclusion of new gases and activities, and what improvements can be made to ensure its continued effectiveness?

EQ3 examines how effectively the MRV maritime system (comprising its regulatory framework, digital infrastructure, and institutional capacities) has adapted to the new challenges stemming from the 2023 revision to prepare for the ETS extension to shipping. More specifically, the analysis assesses the fitness of support to stakeholders' initiatives and technical IT tools, the preparedness of companies, verifiers, NABs and Member State authorities to implement the new requirements, and the extent to which the system's operational effectiveness has been maintained during this transition.

The analysis found that overall, the MRV maritime system has demonstrated a high degree of adaptability in response to the 2023 amendments, successfully absorbing an expanded regulatory scope while maintaining operational continuity and data reliability. The integration of new gases (methane and nitrous oxide – starting 2024), the inclusion of additional ship categories (starting 2025), the introduction of company-level and partial emissions reporting requirements, and the changes to the workflow for compliance documents submission, were all implemented within tight timelines, supported by timely technical upgrades to the IT system THETIS-MRV, and sustained support to implementation available to all relevant actors. Most companies, verifiers, and Member States managed to adjust their procedures in time for the 2024 reporting cycle, and the overall system was ready for the full integration with the ETS framework, as confirmed by the findings on punctuality and completeness of submissions. This allowed for high ETS compliance, paving the way for a smooth start of EU ETS for maritime, with shipping companies surrendering allowances for more than 99% of their relevant

surrendering requirements by the 30 September deadline in 2025. The extension of the reporting system to small general cargo ships and offshore vessels closed a significant coverage gap, ensuring, starting 2025, the monitoring and reporting of emissions by types responsible for a meaningful amount of additional emissions, thus extending the completeness of MRV data.

At the same time, the adaptation process revealed transitional weaknesses stemming from some of the new reporting requirements and changes to the workflow in the compliance process. Uneven familiarity among smaller operators, late or incomplete publication of guidance updates on specific interpretative points, and limited IT system-performance issues have been flagged by some stakeholders as adjustment frictions following the 2023 revision. The evidence suggests that the system can rely on the technical and institutional capacities of relevant authorities to overcome these challenges through further support to stakeholders, provided that the necessary resources, both technical and administrative ones, are made available in the future.

8.5.4.2 Efficiency

The efficiency criterion evaluates whether the monitoring, reporting and verification of greenhouse gas emissions for maritime was implemented cost effectively and whether any options for simplification are apparent with a view to reduce administrative burden on relevant stakeholders. Efficiency is achieved by the MRV system as long as the administrative costs are balanced by tangible gains in data quality, relevance and usability, and wider regulatory synergies (e.g. alignment with ETS, FuelEU, and IMO DCS) are exploited without compromising the effectiveness of the measure. This criterion is developed through three evaluation questions to gain a detailed understanding of the cost elements of the system, to investigate opportunities for further cost reductions and simplification, and to assess the role technology and increased harmonisation could play in supporting efficiency.

- EQ4: Has the MRV maritime system achieved its objectives in a cost-efficient manner for all the parties involved, industry and Member States?

The costs associated to the operation the MRV for maritime are investigated through desk research and the additional input provided through a survey and follow-up interviews with stakeholders implementing the system.

To answer this question, the analysis mainly focused on the recurrent costs for shipping companies, as the costs incurred every year by operators to implement the monitoring and reporting of emissions per each vessel.

The analysis estimated the average median cost for MRV compliance for shipping companies at 3 150 EUR per vessel/year, overall, in line with recent findings from studies carried out on the MRV maritime system (e.g. 3 390 EUR per vessel/year for tonnage above 4,999 GT) and ex-ante assumptions made in the European Commission’s impact assessment (3 470 euro/vessel/year in current prices). Most respondents further indicated that the estimated costs incurred for MRV compliance are in fact shared with other reporting systems, such as EU ETS, FuelEU Maritime, or the IMO DCS, rather than being MRV-only specific. Around half of the inputs received indicated that most of the person-hours employed to ensure MRV compliance are in fact also serving the compliance under those other schemes.

In terms of MRV costs components, the answers collected through survey and follow-up interviews indicate that costs are generally well distributed across a range of activities (staff costs, data collection and internal monitoring, IT systems, verification fees, preparation and

revision of monitoring plans, emissions report preparation and submission, administrative coordination and interactions with relevant authorities). Staff costs emerged as the more prominent cost driver, generally accounting for more than half of total incurred MRV administrative costs, followed by monitoring plans and emissions report preparation and submission, indicated by most respondents as a minor contributor to total costs (less than quarter than total costs). Shipping companies generally find that costs are higher when voyage frequency and/or data granularity are greater, which is often the case for smaller vessels and sometimes for specific vessel segments like containerships and offshore vessels. Most inputs to the survey found MRV compliance costs to have increased following the 2023 revision, mainly in the form of one-off adjustment costs associated with the need to update reporting processes and templates following in particular to adapt to new ETS-related reporting requirements which primarily required additional training to prepare relevant staff.

The analysis further covered verification costs, as a component of the overall MRV costs incurred by shipping companies to comply, which are passed over by accredited verifiers through verification fees. Inputs collected from accredited verifiers indicated that the main verification activities (i.e. monitoring plan and emissions data checks) are highly harmonised and in fact run in parallel across different emissions and energy efficiency reporting regulatory frameworks (i.e. FuelEU Maritime, IMO DCS). In terms of costs composition, verifiers indicated that most resources to ensure MRV verification are absorbed by the review of monitoring plans and of emissions reports, which remain staff-intensive, followed by site visits.

No quantifiable benefits have been identified to allow the extraction of meaningful cost–benefit ratios or any conclusions of how these have performed relative to benchmarks. Yet, the survey could collect some qualitative insight on this point, as half of shipping companies consulted found the data collected through the MRV system to be appropriate, thus suggesting that administrative requirements may be proportional to the benefits of the system. Many companies also reported the use of MRV-derived data for other purposes, such as, in order of relevance, helping to achieve wider business goals including regulatory submissions related to other regulatory frameworks, internal energy management, environmental, social and governance (ESG) goals, customer reporting, and financing. This suggests that significant synergies may at least partially offset the administrative burden to comply with MRV maritime requirements.

- EQ5: Are there opportunities for further cost reductions, including opportunities to streamline or simplify the MRV maritime system process, without compromising effectiveness?

This evaluation question examines whether, and to what extent, the MRV maritime system could be further simplified or streamlined to reduce administrative costs, while preserving the accuracy, transparency, and regulatory effectiveness achieved under the current framework. The 2023 revision of the MRV system have increased the requirements on operators and verifiers but also created opportunities for process integration and data reuse synergies across regulatory regimes. This question therefore assesses the potential for cost reductions through harmonisation, automation, and procedural simplification, identifying measures that could enhance the robustness of the system while reducing redundant effort.

The analysis confirmed the maturity and robustness of the MRV maritime system but also identified some procedural overlaps and administrative inefficiencies that could be reduced through targeted digital and implementation improvements, in the absence of changes to the legislative framework. Most stakeholders perceive duplication not in the MRV design itself,

but in its co-existence with other regimes, particularly FuelEU Maritime and IMO DCS. Survey data show that around 80 % of respondents share MRV-related processes with these other compliance systems and over 90 % routinely cross-check data across regimes. Roughly half reported they encounter occasional discrepancies to reuse relevant data caused by divergent voyage definitions, aggregation rules or validation logic.

At the same time, the analysis found that developments undertaken in the THETIS-MRV IT system following the 2023 revision to prepare for the ETS extension to maritime and the targeted support to implementation provided by relevant authorities have been considerably reducing duplications in implementation and improving interoperability across systems already. This suggests that remaining cost-saving potential is likely to lie mainly in further digital alignment, additional and updated guidance, and possibly expanding targeted training opportunities for smaller operators and verifiers.

These targeted improvement elements within the existing MRV legislative framework for maritime are found to be achievable without compromising data quality or regulatory robustness. The priority should therefore be to enhance the integration and consistency of existing digital and methodological processes, rather than introduce new obligations, thereby reinforcing both efficiency and effectiveness of the MRV maritime framework.

• EQ6: What role can technology (e.g., digitalisation, automation) and increased harmonisation play in improving the efficiency of the MRV maritime system, and what investments are needed to realise these benefits?

This evaluation question explores how the use of technology (in particular digitalisation and automation) and the degree of harmonisation across processes, tools and actors, contribute to the efficiency of the EU maritime MRV system. It also considers what further investments may be required to fully realise these potential efficiency gains.

The assessment focuses on the extent to which the current digital infrastructure (notably the THETIS-MRV platform managed by EMSA) and the associated harmonised procedures (templates, verifier accreditation, common guidance, and data publication) reduce administrative effort, improve data quality and facilitate compliance for all actors involved. These include shipping companies, managers, verifiers, NABs, Member State authorities, EMSA and the European Commission. The evaluation considers both current efficiency gains achieved through digitalisation and harmonisation and remaining inefficiencies that hinder further optimisation, before identifying key investment priorities and potential future improvements such as enhanced interoperability, automation, and data exchange between systems.

Overall, the evidence indicates that further efficiency gains could primarily stem from deeper digital integration and automation, while long-term cost reductions and implementation consistency will depend on complementary investments in human and institutional capacity. Both strands are mutually reinforcing and should be pursued in parallel to consolidate the efficiency and effectiveness of the MRV maritime framework. The further consolidation of workflows within THETIS-MRV, the introduction of automated validation checks to detect potential outliers and typos, and the use of harmonised templates have markedly reduced already administrative duplication and facilitated consistency across companies, verifiers, and national authorities. Approximately half of the companies replying to the survey reported a positive experience with the IT platform, and a majority of verifiers indicated shorter verification cycles and fewer manual interventions compared to the MRV implementation phase before the revision (i.e. 2018-2023). Member States similarly acknowledged that the

centralisation of verified MRV data and shared access to Documents of Compliance have simplified enforcement and reduced redundant exchanges of information.

At the same time, the evaluation highlighted residual inefficiencies that limit the full realisation of these benefits. The most significant barriers identified by companies and verifiers relate to incomplete interoperability between THETIS-MRV and companies IT systems, which still requires partial manual data entry or file uploads. Other recurring concerns include usability and performance issues following system updates and limited analytical capacity and staff resources in several national administrations. These findings align with external analyses showing that while MRV data are reliable and comprehensive, overlaps with other reporting frameworks (e.g. IMO DCS) continue to impose redundant administrative effort.

Addressing these challenges will require targeted investment and capacity-building, both from regulators and business actors (i.e. shipping companies, verifiers, other services providers). Stakeholders and authorities emphasised the need for continued investments in API development and full automation of data exchanges, enhanced training and technical support for different user types, and reinforced cybersecurity and maintenance budgets as the THETIS-MRV system is being constantly updated to cater for both ETS and FuelEU Maritime requirements. Illustrative examples of potential efficiency improvements mentioned by stakeholders include:

- implementation of automated data transfers from fuel suppliers (e.g. through electronic Bunker Delivery Notes or fuel sustainability documentation) directly into THETIS-MRV.
- deployment of advanced analytics and Artificial Intelligence-based anomaly detection tools to support risk-based verification.
- enhanced API interoperability allowing companies' internal systems to exchange data directly with THETIS-MRV without manual uploads.

These examples illustrate that most efficiency gains expected in the next phase will derive from investments in deeper automation, stronger inter-system connectivity, and improved analytical capacity.

8.5.4.3 Relevance

This criterion was developed through two evaluation questions to assess to what extent the objectives and design of the MRV maritime system remain relevant to the objectives of the overall EU climate policy framework, including by addressing current and emerging challenges.

- EQ7: To what extent do the objectives and design of the MRV system remain relevant to the objectives of the compliance cycle and the overall EU climate policy framework, and are they still appropriate in light of the evolving regulatory context?

The assessment of this evaluation question focused on three key objectives of the MRV system:

- Provide harmonised, high-quality emissions data across all relevant ship categories and gases.
- Enable the effective implementation and enforcement of the EU ETS for maritime transport.
- Reduce administrative burden and ensure legal and regulatory certainty for operators and Member States.

These objectives were assessed against the relevance of the MRV system for the EU climate policy, its compatibility with the EU ETS and FuelEU Maritime compliance cycles, the usefulness of the data reported to different stakeholders groups, the responsiveness of the scope and structure of the system to sectoral changes, and the level of support of the reported data to EU ETS, FuelEU Maritime and the Renewable Energy Directive (RED) frameworks.

The analysis found that MRV provides accurate data on maritime greenhouse gas emissions and energy efficiency that serve as the primary data source for the operation of EU ETS and for the implementation of FuelEU Maritime requirements. Its scope is overall aligned with the EU ETS in terms of ships and emissions covered and its verification and reporting timelines are synchronized with EU ETS deadlines. As such, the MRV maritime system is closely aligned with the EU's climate policy, one of its key objectives being to support the implementation of the EU ETS compliance cycle.

The data collected under the MRV maritime system are relevant and useful for stakeholders beyond the scope of MRV compliance alone, being used for compliance with FuelEU Maritime, IMO DCS, as well as for ESG, internal energy management, customer reporting and financing purposes.

The MRV Regulation has demonstrated a high level of responsiveness to sectoral changes in maritime transport, aligning to evolving EU climate and transport legislation, market dynamics, and technological advancements. The expansion of its scope to include additional vessel types and greenhouse gases reflects a proactive approach to capturing more comprehensive emissions data, for instance in relation to the uptake of new fuels (e.g. LNG).

The MRV system provides essential support to the implementation of EU ETS, FuelEU Maritime, and RED III by supplying verified emissions and fuel consumption data that underpin relevant compliance and reporting mechanisms. Stakeholder feedback confirms the system's foundational role but also highlights areas for improvement, particularly insofar further alignment between MRV and EU ETS and FuelEU Maritime systems, usability, and digital integration.

- EQ8: To what extent are the scope and structure of the MRV system appropriate to address current and emerging challenges?

The readiness of the MRV system to adapt to current and emerging challenges was analysed in relation to the inclusion of non-CO_2 gases under its scope starting 2024 and in terms of its capability in handling the increased data quality and complexity stemming from the 2023 revision without compromising data quality or usability.

The analysis found that the monitoring and reporting provisions of the MRV maritime system have been broadly adequate in covering the newly included greenhouse gases (methane and nitrous oxide) and vessel categories (offshore ships and small general cargo vessels), following the 2023 revision. The secondary legislation developed following the revision provided clear templates and definitions, enabling technical adaptation of the THETIS-MRV platform and timely procedural adjustments by relevant stakeholders. However, the majority of surveyed companies and a significant share of verifiers, flagged the support for more detailed and more timely guidance on the legislative requirements of the system, so to ensure consistent implementation and further uphold stakeholder compliance under the expanded MRV scope.

The MRV maritime system has demonstrated a general capability to handle the increased data volume and complexity without compromising overall data quality or usability. Following the 2023 amendment, the THETIS-MRV IT platform, which companies, verifiers and

Administering Authorities are required to use to implement and enforce the system, accommodated the changes without performance degradation. While some of the respondents flagged potential technical improvements to further enhance efficiency and data accuracy, the IT system's core functionalities remain adequate, also thanks to EMSA ability to adapt it to emerging needs and inputs from users, as in the case of a built-in validation mechanisms to flag likely inconsistencies and errors, confirming the adaptability of the IT system to emerging needs.

8.5.4.4 Coherence

The evaluation of coherence assesses how well the MRV maritime system is functioning in a harmonised way with other regulatory frameworks pursuing or supporting shipping decarbonisation objectives, both at the EU level and globally. This criterion has been analysed through three evaluation questions, both to assess the overall systemic coherence with measures at global level (IMO DCS) and at the EU level (EU ETS, FuelEU Maritime, RED), but also to detect potential areas of conflict.

- EQ9: Has the MRV been coherent with the IMO DCS?

The MRV maritime system set in Regulation (EU) 2015/757 and the IMO DCS both require the monitoring and reporting of the fuel consumption from ships as means to inform policy makers and design policy tools towards the reduction of emissions from shipping. The basic general requirement of monitoring and aggregating fuel consumption data is therefore common to the two systems and the three monitoring methods being applied under the MRV system are also accepted under the IMO DCS. Despite such general design similarities, several details in the measures details result in divergences between the two systems. For example, the scope of affected ships is not fully harmonised, and the IMO DCS mandates fuel consumption reporting, excluding the quantification of greenhouse emissions. Differences also exist in the verification processes: the MRV system requires third-party independent verification, while the IMO DCS relies on flag state procedures based on IMO guidelines. A further area of divergence concerns data transparency. The MRV mandates full public disclosure of a defined set of data, capable of gaining a general understanding of the emissions and energy efficiency performance of the fleet, with granularity at ship level. In contrast, the IMO DCS only publishes anonymized, fleet-level aggregated data, through an annual report. The full alignment on these elements would imply structural changes to the MRV system, in a manner not compatible with the measure's effectiveness in delivering on its policy objectives.

On the contrary, there are some other divergencies between the two systems which could be mitigated without compromising the overall design of the measure, thus minimising administrative burden for operators. This is the case of some inconsistencies in definitions applicable to reporting parameters (e.g. on time and distance travelled), or in the type and detail of information required where the requirement to report fuel consumption by consumer type (e.g., engines vs. boilers) under IMO DCS could represent an added value also under the MRV system.

In conclusion, the evaluation underscored some divergences in the design and implementation of the MRV and IMO DCS system, which determine duplications for the entities required to comply with both schemes. Despite such differences which are mostly inherent to the different objectives of the measures, the evaluation identified the potential for closer alignment in respect to some limited reporting requirements and applicable definitions between the two system. To the extent that these remain compatible with the policy objectives and effectiveness of the MRV

maritime system, these could reduce the administrative burden for operators and further enhance the granularity of the reporting requirements under MRV.

- EQ10: Has the MRV maritime system been coherent with the EU ETS legal framework and, secondly, how well does the MRV maritime system align with other EU policies such as FuelEU and the RED?

The EU MRV is highly coherent with the EU ETS framework. This coherence is by design, as the MRV system provides the verified greenhouse gas emissions data required for ETS implementation for shipping. The coherence is ensured through definitions, cross references in key legal instruments, a common verification system for reported data, and an align aligned administrative process which is integrated within the THETIS-MRV platform.

The MRV system used for ETS compliance and FuelEU Maritime are slightly less aligned while maintaining overall coherence. The different approaches to the regulated entity may result in two different entities being responsible for the same ship under FuelEU on the one hand, and under EU ETS/MRV on the other hand[293]. Further differences exist in the scope of application: FuelEU applies to a slightly different subset of ships in terms of size and type than the MRV system. The MRV system mandates the reporting of tank-to-wake (TtW) CO_2e emissions, whereas FuelEU requires the calculation of well-to-wake (WtW) GHG intensity. As a result, FuelEU requires additional fuel characteristics and life-cycle data that are not relevant under the MRV system. The monitoring and reporting requirements between MRV and FuelEU are generally aligned, but some divergences persist: FuelEU requires some additional parameters to be reported, which currently prevents the use of unique templates for reporting purposes (i.e. monitoring plans and emissions reports). Despite these differences, both systems share high consistency in the methods for monitoring fuel consumption, rules for determining emission factors, and procedures for verifying the sustainability and GHG savings of alternative fuels. Data submission by users is further facilitated by THETIS-MRV, as a shared digital single interface for compliance.

8.5.4.5 EU added value

- EQ11: To what extent has the MRV system delivered added value at EU level compared to what could have been achieved through acting by individual Member States?

The EU maritime MRV framework has delivered added value compared to what could have been achieved through uncoordinated national action. The Regulation replaced a fragmented landscape of partial or voluntary national initiatives with a harmonised, legally binding and verifier-based system covering all ships calling at EU ports. The establishment of common templates, definitions and accreditation procedures, supported by the mandatory use of a centralised THETIS-MRV IT platform, has ensured uniform data quality, administrative efficiency and transparency across Member States. The system has reduced compliance costs, avoided duplication and overlap of verification markets, and provided the methodological and technical foundation necessary for the integration of maritime transport into the EU Emissions

[293] The definitions of the regulated entity under EU ETS/EU MRV and FuelEU Maritime are aligned. The legally non-binding FAQs of FuelEU Maritime explain that the 'ISM Company' distinct from the shipowner is the entity responsible for compliance with FuelEU Maritime. By contrast, under EU ETS and EU MRV, the regulated entity can be either the shipowner or the ISM Company, with the shipowner being the regulated entity by default. The ISM Company refers to the entity responsible for the compliance of a ship with the requirements of the International Management Code for the Safe Operation of Ships and for Pollution Prevention.

Trading System. In the absence of EU intervention, Member States would have implemented divergent or overlapping schemes, increasing costs and undermining data comparability and policy coherence. The EU-level approach has therefore generated economies of scale, ensured a level playing field for operators, and strengthened the overall effectiveness of the Union's climate-policy framework in the maritime sector.

- EQ12: To what extent has the EU-level MRV maritime system enabled results that would not have been possible through MS national systems alone, in terms of supporting ETS implementation and broader EU climate objectives?

The analysis found that the EU-level MRV maritime framework has enabled outcomes that Member States acting individually could not have achieved. By establishing a harmonised, verifier-based, and digitally integrated monitoring system, it provided the essential infrastructure for extending the EU ETS to maritime transport and for supporting the Union's broader decarbonisation objectives. The system's verified and transparent emissions database now serves as the reference for ETS compliance, the assessment of fuel and energy-efficiency measures, and evidence-based policy design across multiple climate instruments.

In the absence of EU intervention, Member States would likely have implemented divergent or voluntary monitoring schemes, leading to inconsistent data, higher administrative costs, and limited policy interoperability. The MRV system therefore represents a clear case of EU added value: it has created the analytical, regulatory and technical foundation for the integration of maritime transport into the EU climate framework and for the Union's leadership in global maritime decarbonisation.

8.5.5 Conclusions

The evaluation of the MRV maritime system confirmed the effectiveness and efficiency of the framework in ensuring the reporting of accurate, complete, and transparent greenhouse gas emissions data from maritime transport activities. The revision of the system, effective as of the 2024 reporting period, brought an expansion of the activities under scope as well as additional complexity for operators.

The evaluation found that stakeholders were overall well prepared and adapted quickly to these new challenges, thus ensuring that the MRV system could keep fulfilling its policy objectives as the ETS extension to maritime came to implementation. While the system can at present rely on a centralised digital infrastructure for reporting and compliance, on the use of uniform mandatory templates, and on robust support to implementation, some temporary adjustment frictions following the 2023 revision were detected during the evaluation. These may require closer attention by relevant authorities, in the form of sustained support to implementation, continuous adaptations of the IT infrastructure, and closer attention to potential capacity limitations in the verification and accreditation system.

Consulted stakeholders overall confirmed that administrative requirements are proportional to the benefits of the system and that the MRV maritime system is delivering its objectives cost-efficiently. While the evaluation found the average recurrent compliance cost per vessel to be in line with previous estimates, operators also highlighted having incurred one-off adjustment costs following the 2023 revision. Most of the consulted stakeholders indicated that MRV compliance costs are in fact shared with other reporting systems, such as EU ETS, FuelEU Maritime, or the IMO DCS, rather than being MRV-specific, and that MRV-derived data is used for other purposes within the company, including internal energy management, ESG goals, customer reporting, and financing. This indicates that MRV compliance costs for

operators are at least partially offset due to interdependencies with other regulatory frameworks or business goals.

Despite such evident synergies, the evaluation also identified some procedural overlaps and discrepancies between the MRV system and other regulatory frameworks mandating emissions and energy efficiency data reporting to the shipping sector. These may result in administrative inefficiencies for operators being required to comply with parallel yet somewhat divergent requirements under MRV, EU ETS, FuelEU Maritime, and IMO DCS. The evaluation found that some of these could be addressed under the current legislative framework through investments in deeper digital integration, automation in data management and reporting, further guidance and targeted training opportunities for users. Others, such as discrepancies in definitions, monitoring and reporting requirements, or overlaps in compliance processes, could be mitigated through legislative amendments to the MRV maritime Regulation or FuelEU Maritime, to be considered against their potential in terms of cost reductions and compatibility with the effectiveness of the measure. Aligning the approach to the regulated entity under FuelEU and EU ETS/MRV Maritime would ensure that one entity is responsible for compliance with the monitoring and reporting requirements under FuelEU and EU ETS/MRV Maritime. This would in turn enable the implementation of the monitoring-and-reporting-only-once principle.

In conclusion, the findings indicate that the MRV maritime system functions as a robust framework, which has demonstrated its capability to handle the increased data volume and complexity stemming from the 2023 revision without compromising overall data quality or usability, while delivering added value compared to uncoordinated national action efficiently. The evaluation found that rather than a structural overhaul of the system, incremental improvements through investments in technology and simplification initiatives could further enhance the harmonised and robust implementation of the system, thus ensuring the policy objectives of the measure and notably the adequate support to the ETS implementation for maritime transport.

8.6 Union Registry

8.6.1 Introduction

The Union Registry is a system of electronic databases established in 2012 and serves to guarantee accurate accounting for all allowances issued under the EU Emissions Trading System (EU ETS). The Union Registry hosts over 16 000 operator (compliance entity) and trading accounts. While the number of yearly transactions is below 100.000, the average value of allowances held on the accounts exceeds 200 billion EUR. This evaluation is based on the 2015 ETS Directive assessment, which examined the performance of the Union Registry. The assessment focuses on the Union Registry's effectiveness and efficiency in carrying out its key tasks, including the allocation, surrender, and cancellation of allowances, as well as the tracking of transfers and administration of central holding accounts. The overall goal of the evaluation is to determine whether the Union Registry can execute these tasks in a secure, robust, and cost-effective manner, ensuring the integrity and reliability of the system.

The ETS Directive provides the main requirements for the functioning of the Union Registry. The Directive stipulates that the Union registry holds all EU ETS allowances (EUAs) issued from 1 January 2012 onwards and executes processes related to account maintenance, allocation, surrender, and cancellation of allowances. The Union Registry must be public and allow anyone who fulfils the criteria (compliance entity or trading account) to hold allowances. And finally, Union registry must have modalities in place for undertaking transactions, implementing arrangements, and managing changes and incidents.

The Commission was empowered to adopt delegated acts to establish a standardised and secured system of the Union Registry that tracks and manages the issuance, holding, transfer, and cancellation of EUAs and other units. The Registry Regulation[294] sets out rules for account management, allowance issuance, Kyoto units, and compliance, and establishes a centralised electronic database. The Registry Regulation enables the Union Registry to comply with the requirements for Phase IV set by the revised ETS Directive, for example by adjusting the functionalities so that allowances are valid indefinitely and can only be used to cover emissions as of the first year of the ten-year period in which they were issued, as well as to ensure that international credits cannot be used to cover emissions as of 2021. Moreover, the new Regulation was adapted following the classification of emission allowances as 'financial instruments' under Directive 2014/65/EU14 (MiFID2)[295] as of 3 January 2018 and updated with the requirements of the revised data protection rules.

An essential component of the Union Registry is the EU Transaction Log (EUTL[296]). For transparency, the public website discloses all transactions older than three years. Additionally, it provides easy access to data for researchers, policymakers, and other stakeholders to analyse trends and make informed decisions.

The management of the system is shared by several stakeholders. The central administrator whose main responsibilities are to provide, operate and maintain the Union Registry, to manage

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294 Commission Delegated Regulation (EU) 2019/1122 of 12 March 2019 supplementing Directive 2003/87/EC of the European Parliament and of the Council as regards the functioning of the Union Registry (Text with EEA relevance)

295 Directive 2014/65/EU of the European Parliament and of the Council of 15 May 2014 on markets in financial instruments and amending Directive 2002/92/EC and Directive 2011/61/EU (recast) Text with EEA relevance

296 As of 2024 the EUTL has changed its name to become Union Registry public website: https://union-registry-data.ec.europa.eu/report/welcome

central accounts and to perform operations which are carried out centrally (such as issuing of allowances).). The Commission assigned the task of the central administrator of the Union Registry to the Director General of DG CLIMA.

There are also national administrators who manage the accounts under their jurisdiction. It is the national administrators' main responsibilities to be the contact point with their respective account holders in the Union Registry and perform all operations involving direct contact with them, including the opening, suspension, and closure of accounts. To participate in the ETS, for compliance or trading of allowances, legal or natural persons must open an account in the Union Registry. To open an account, the persons must send a request to their respective national administrator, who collects and verifies all supporting documentation. Once their request is approved, they receive credentials to access their account on the Union Registry portal.

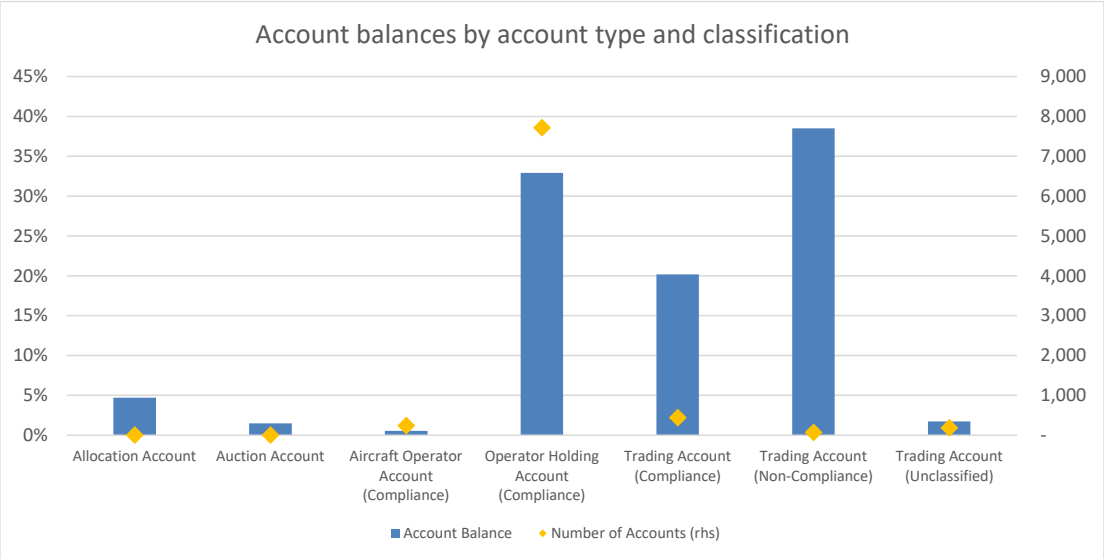
The Union Registry keeps records of the accounts of Member States and all transactions of EUAs performed. Furthermore, national implementation measures are documented, including the list of installations covered by the EU ETS in each country and the free allocations to each of those installations. The Union Registry also records annual verified CO_2 emissions from installations and aircraft operators, as well as the surrendered allowances by the compliance entities to ensure that they cover all verified emissions.

The Registry Regulation outlines the types of accounts to manage emissions allowances. operator holding accounts and aircraft operator accounts enable installations and aircraft operators to comply with their emissions. Person holding accounts allow market participants to buy, sell, or hold allowances. Trading accounts facilitate market transactions without compliance links. One allocation account and one auction account are both run by the Commission (Central Administrator), and represent the accounts used to distribute newly issued EUAs via free allocations and auctions, respectively. In 2022[297], the analysis of the outstanding balance reveals that most allowances are held in Operator Holding Accounts and Trading Accounts.

There were almost 7,700 Operator Holding Accounts, holding around 33% of outstanding allowances. Combining this with the Trading Accounts of compliance operators, 53% of EUAs were held by compliance entities. Another 39% were held in the Trading Accounts of non-compliance entities.

[297] ESMA report 'Emission Allowances and derivatives thereof'. In 2022 ESMA has analysed the data regarding emission allowances gathered from different sources, including EU Registry. The results of the analysis are the report

Figure 33: Share of outstanding account balances and number of accounts, by account type and entity classification.



Source: European Commission, GLEIF, Refinitiv, ESMA.

When looking at the balances and number of accounts, it's clear that EUAs are more concentrated in Trading Accounts than in Operator Holding Accounts. In fact, the top 10 companies hold 36% of all EUAs, and the top 100 companies hold 75%. This shows that a small number of companies control a large portion of EUAs.

However, it is important to state that compliance entities sometimes open trading accounts as well, in addition to the compulsory compliance account. In 2022, the Union Registry holds 3.1 billion general allowances and 38.5 million aviation allowances, worth about EUR 79 billion. Yearly, around 8 billion allowances, worth EUR 200 billion, are exchanged between accounts. It is imperative to safeguard the integrity of the Union Registry. Considering the high value of the allowances in the Registry, it is worth evaluating its functioning.

This evaluation primarily considers the provisions outlined in the ETS Directive in particular the principles governing the Registry system listed in Article 19. According to these principles, the Union Registry should be designed to ensure that:

- **Central Registry**: All allowances issued from January 1, 2012, onwards must be recorded in the Union Registry.
- **Public Access:** The Registry must be publicly accessible, allowing anyone to view the accounts and transactions of allowances.
- **Standardised Tracking**: The Registry must track the issuance, holding, transfer, and cancellation of allowances in a standardized and electronic format.
- **Transparency and Security**: The Registry must ensure transparency and security in its operations, including provisions for confidentiality, incident management, and change management, to maintain the integrity of the emission system.
- The **technical** details are to be laid down in a Regulation adopted by the Commission.

The technical specifications are outlined in the Registry Regulation and are generally outside the scope of this evaluation, except for one notable provision. Given the importance and value of the allowances and the number of transactions the functioning of the Union Registry requires resources. Article 81(2) of the Registry Regulation allows national administrators to impose "reasonable fees" on account holders for accounts under their administration, provided they

notify the European Commission. The Commission is then required to make this information publicly available on its website. However, the fees levied on accounts holders in the Union Registry vary substantially across Member States, prompting prolonged discussions on potential harmonization of these fees.

The Union Registry covers a variety of instruments, including EUAs, EUAA, Certified Emission Reductions (CERs) and Removal Units (RMUs) and their Swiss equivalents (CHUs & CHUAs). Indeed, the agreement on linking the EU ETS with Switzerland's ETS entered into force on 1 January 2020. To operationalise the link between the emissions trading systems, the parties agreed to establish a provisional solution for linking the two registries and enabling the transfer of allowances between them. Also, from 1 January 2019, the Commission suspended all processes for the UK relating to free allocation, auctioning and the exchange of international credits, in accordance with the safeguard measures to protect the environmental integrity of the EU ETS in cases where EU law ceases to apply to a Member State withdrawing from the EU.

The evaluation will focus on EUAs and EUAAs, which represent by far the largest proportion of the market.

8.6.2 Point of comparison

The Union Registry has been governed by the provisions laid out in Article 19 of the ETS Directive.

- (1) Allowances issued from 1 January 2012 onwards shall be held in the Union registry for the execution of processes pertaining to the maintenance of the holding accounts opened in the Member State and the allocation, surrender and cancellation of allowances under the Commission Acts referred to in paragraph 3. Each Member State shall be able to fulfil the execution of authorised operations under the UNFCCC or the Kyoto Protocol.
- (2) Any person may hold allowances. The registry shall be accessible to the public and shall contain separate accounts to record the allowances held by each person to whom and from whom allowances are issued or transferred.

The 2018 revision of the ETS Directive has added the empowerment for the Commission to adopt requirements for the functioning of the Union Registry, included in paragraph 3 of Article 19:

- (3) The Commission is empowered to adopt delegated acts in accordance with Article 23 to supplement this Directive by laying down all necessary requirements concerning the Union Registry for the trading period commencing on 1 January 2013 and subsequent periods, in the form of standardised electronic databases containing common data elements to track the issue, holding, transfer and cancellation, as applicable, of allowances, and to provide for public access and confidentiality, as appropriate. Those delegated acts shall also include provisions to put into effect rules on the mutual recognition of allowances in agreements to link emission trading systems.

On the basis of this empowerment, the Commission developed and adopted Commission Delegated Regulation (EU) 2019/1122 supplementing Directive 2003/87/EC of the European Parliament and of the Council as regards the functioning of the Union Registry (the Registry Regulation). The regulation covers several aspects, including the following:

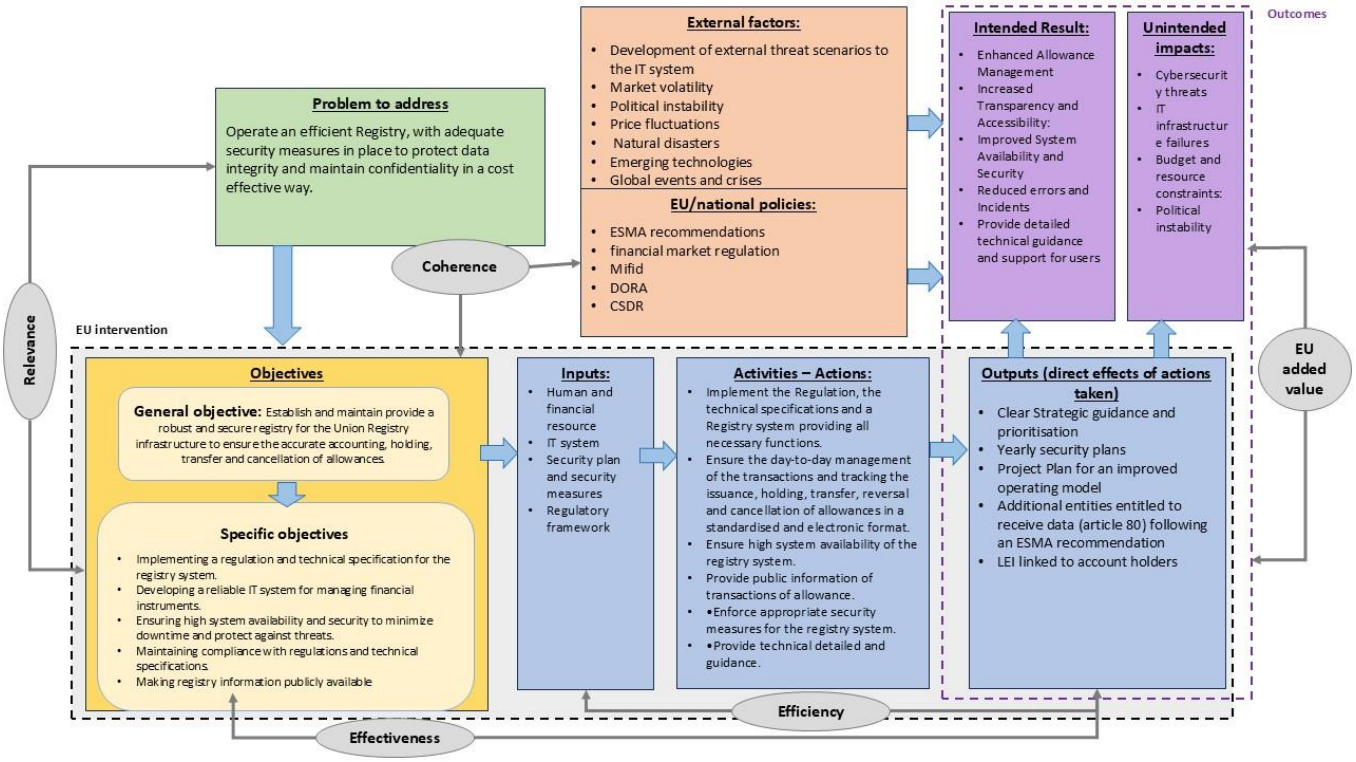
- The registries system is operated and maintained by a **central administrator** and **national administrators**.

- The regulation **simplifies rules on account management** with the aim of reducing the burden on national administrators.
- Specific rules for the EU ETS registry regarding issues such as:
    - verified emissions and compliance.
    - transactions, including rules on the execution of transfers and the creation, allocation and transfer of allowances.
    - trusted account lists for transactions above a particular threshold (value) to be set by the central administrator, to ensure high-value transactions are secure.
    - improving links between the EU ETS and other ETS schemes where a linking agreement has been concluded (e.g. the Swiss ETS – see summary).
- Where **discrepancies** are detected, the central administrator must ensure that the registry terminates the relevant processes and must inform the relevant account or allowance holders that the process has been terminated.
- **Technical rules and requirements** for the registry, including national helpdesks for account holders and representatives.

8.6.3 Intervention logic

Figure 34: Intervention logic Union Registry

Source: Own illustration



8.6.3.1 Problem to address

Operate an efficient Registry, with adequate security measures in place to protect data integrity and maintain confidentiality in a cost-effective way. Continuous evaluations of the Union Registry have identified structural issues inside the Commission that prevent from reaching appropriate security levels. This is expressed in a reservation in the AAR Commission's Annual Activity Report since 2010. Commission IT services are designed to support most IT

needs inside the Commission, but they do not come up to the levels required by the need to manage financial instruments.

8.6.3.2 Objectives

General objective:

The general objective is to establish and maintain a robust and secure registry for the Union Registry infrastructure to ensure the accurate accounting, holding, transfer and cancellation of allowances.

Specific objectives:

- The primary objective is to establish a comprehensive registry system. This involves implementing a Regulation for the registry system and a detailed technical specification that enables it to perform its intended functions efficiently and effectively.
- Providing an IT system that ensures appropriate management of financial instruments.
- Ensuring the registry system is reliable and accessible, a high level of system availability must be maintained to minimize downtime in case of system failures.
- Ensuring the security of the registry system and taking appropriate measures to protect it from potential threats.
- Ensuring compliance with the Regulation and technical specification.
- Making the information publicly available.

8.6.3.3 Actions

- Implement the Regulation, the technical specifications and a Registry system providing all necessary functions.
- Ensure the day-to-day management of the transactions and tracking the issuance, holding, transfer, reversal and cancellation of allowances in a standardised and electronic format.
- Ensure high system availability of the registry system.
- Provide public information of transactions of allowances.
- Enforce appropriate security measures for the registry system.
- Provide technical details and guidance.

8.6.3.4 Inputs:

- Human and financial resources to maintain the Registry system. IT system for the management of the financial instrument
- Security plan and security measures
- Strong regulatory framework

8.6.3.5 Outputs

- A fully functional Registry system with technical specifications and an implementation plan in place, providing all necessary functions for managing allowances.
- A standardised and electronic system for tracking and managing transactions, including issuance, holding, transfer, and cancellation of allowances.
- A highly available registry system with minimal downtime, ensuring continuous access to allowance management functions.
- Prevention of market abuse, so that integrity is ensured.
- A publicly accessible platform for viewing transactions of allowances, to ensure transparency and accountability.

- A comprehensive security plan for the Registry system, including measures to prevent security threats, with regular audits and reviews to ensure compliance.
- Detailed technical guidance and support for users of the registry system, including user manuals, training materials, and technical assistance, to ensure effective use and management of the system.

8.6.3.6 Intended Results

- **Enhanced Allowance Management:** Establish a fully functional Registry system and ensure that the registry system provides a robust and reliable platform for managing allowances, enabling efficient and effective tracking and management of transactions.
- **Improved System Availability and Security**: Ensure that the Registry system is highly available, secure, and compliant with relevant standards and regulations, minimizing downtime and preventing security threats.
- **Increased Transparency and Accessibility**: Provide a standardised and accessible platform for stakeholders to access information and manage allowances, promoting transparency and accountability.
- **Reduced errors and Incidents:** Reduce the number of incidents and errors associated with allowance management to ensure a more efficient and reliable system.
- Provide detailed technical guidance and support for users of the registry system, including user manuals, training materials, and technical assistance, to ensure effective use and management of the system.

8.6.3.7 Unintended results and impacts

- **Cybersecurity threats**: Hacking, phishing, and other cyberattacks can compromise the security and integrity of the Registry system.
- **IT infrastructure failures**: Failures of hardware, software, or network infrastructure can cause downtime, data loss, or system crashes.
- **Budget and resource constraints**: Limited budget or resources can restrict the Registry system's development, maintenance, or operation.
- Political instability.

8.6.3.8 External factors

- Development of external threat scenarios to the IT system
- Market volatility
- Political instability
- Natural disasters: Earthquakes, floods, or other natural disasters can damage or destroy infrastructure, causing system downtime or data loss.
- Emerging technologies: Rapidly evolving technologies such as artificial intelligence, or cloud computing, can challenge the Registry System.
- Global events and crises: Global events, such as pandemics, can create new challenges requiring adaptability and resilience.

8.6.4 Evaluation of findings

8.6.4.1 Effectiveness

The effectiveness of the Registry system will be evaluated via the following questions:

- EQ1: To which extent registry system was fully operational, with a reliable and accessible IT system that ensures efficient management?

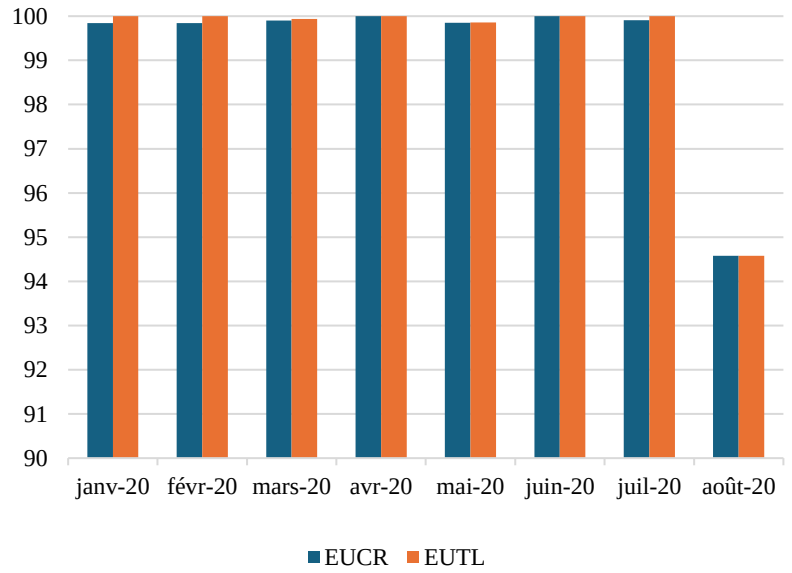
The Union Registry and the EUTL operated seamlessly for the entirety of 2018, with only minor technical interruptions totalling approximately 26 hours. These brief disruptions were necessary for scheduled upgrades and did not significantly impact overall functionality. In 2019, the system maintained its high level of performance, experiencing only minor interruptions that added up to around 7 hours, again due to technical upgrades[298].

However, in 2020, the Union Registry encountered unexpected technical difficulties, resulting in a temporary unavailability on August 18, 2020. Several transactions were not processed correctly during this time. Prompt action was taken and troubleshooting and repair work were conducted between August 19 and 21. Following these efforts, the Union Registry resumed full operation, ensuring uninterrupted service to its users.

During the evaluation period, the Union Registry encountered several minor incidents, including technical glitches, EU Login issues, SMS routing problems, and network connectivity disruptions. Although these incidents were limited in scope and did not affect all users, they still caused brief disruptions to the service. This underscores the importance of ongoing maintenance and improvement efforts to guarantee stability, reliability, and overall performance of the system.

[298] ETS Service Desk report

Figure 35: Availability of the registry system from January to August 2020



Source: ETS Service Desk

To ensure efficient management of allowances in the Union Registry by all stakeholders involved, including the Commission, the central administrator, Member States competent authorities, National Administrators, and account holders, the Commission provided a robust framework enshrined in the Terms of Cooperation adopted in accordance with article 7 of the Registry Regulation. This framework provides stakeholders with the necessary guidelines to operate the system in accordance with applicable regulations, including security and confidentiality requirements, protection of personal data, and the use of secure means of communication, as well as user education and development.

- EQ2: Is the information provided by the registry system accurate, up-to-date, and easily accessible to the public,

The data recorded in the Union Registry and the EUTL is an important source of information for various types of ETS reporting. The EUTL website serves as a vital resource for promoting transparency, accountability, and compliance within the EU ETS. By providing unrestricted access to data on emissions trading, the website enables the public to track the allocation, transfer, and surrender of allowances, as well as verified emissions from compliance entities participating in the system. This not only facilitates compliance monitoring but also fosters market integrity by preventing fraudulent activities and ensuring a fair and efficient trading environment. Furthermore, the website's easily accessible data enables researchers, policymakers, and environmental organizations to analyse trends, conduct studies, and make informed decisions.

Table 15: Compliance data 2018-2023: Public Union Registry

Year	Op. Reported	Op. Surrendered	Verified Emission	% YoY	Surrendered Units	%	Allocations
2023	10.481	8.390	1.150.199.843	-15,5 %	1.153.661.430	100,3 %	559.026.924
2022	10.560	8.460	1.361.850.781	-0,2 %	1.358.745.816	99,8 %	565.112.263
2021	10.879	8.573	1.364.436.716	-1,2 %	1.360.207.303	99,7 %	569.352.868
2020	12.094	9.982	1.380.952.173	-13,6 %	1.370.083.511	99,2 %	674.216.759
2019	12.385	10.372	1.598.557.918	-8,7 %	1.583.910.898	99,1 %	697.807.029
2018	12.523	10.505	1.750.590.404	-3,8 %	1.737.025.162	99,2 %	718.274.508

The Union Registry appears to meet transparency and accountability requirements by providing publicly available and regularly updated data on greenhouse gas emissions. The data, which covers the years 2018 to 2023, shows detailed information on the number of operators the verified emissions and the surrendered units.

However, one key challenge with using the EUTL data from a financial supervisory perspective was the limited availability of legal entity identifiers (LEIs) that can be used to uniquely pinpoint account holders/legal entities and match those with other data sources for market analysis purposes. LEIs were only recently introduced as a requirement to open an account in the Union Registry and are not consistently filled in by account holders and/or checked by the National Administrators.

- EQ3: To what extent do the technical rules and requirements for the Registry system, effectively support account holders and representatives?

The Union Registry provides access to the data to the National Administrators. They can access the necessary data concerning users, accounts, transactions and compliance data pertaining to accounts of the relevant Member State.

The Commission put in place measures to help users to operate the Union Registry to resolve technical issues and ensure the overall security and integrity of the system. The ETS Service Desk, set up by the Commission, acts as a second-level support for incidents related to the software and IT infrastructure of the Union Registry. Additionally, the Commission provides guidance, tools, and information[299] to national helpdesks to improve their responses to incidents. The Commission also monitors the quality of incidents raised by national helpdesks and aims to improve response times and quality. Furthermore, the Commission supports national helpdesks in providing local support to account holders and authorized representatives, enabling them to resolve issues and help users.

- EQ4: Are the security measures in place sufficient to ensure integrity of the system and confidentiality of the data?

The Commission has implemented a security framework to protect the confidentiality and integrity of the data held in the EUTL and the Union Registry. A yearly IT Security Plan for

[299] Registry system - European Commission

the Union Registry System has been developed to manage the security of the Registry System and implementing security measures to protect against potential threats. It identifies the system's functionality, roles and responsibilities, user population, operational status, and business requirements. The plan also conducts a business impact analysis to identify potential risks and assess the attractiveness of the assets to potential attackers. Additionally, it includes a risk assessment to identify potential security risks and selects treatment strategies to mitigate them.

The terms of cooperation[300] contain also detailed security measures including on the confidentiality of sensitive information. Minimum security requirements have also been established for account holders. Secure means of communication are also used to prevent unauthorised access to the Union Registry. Furthermore, national administrators and the central administrator are required to exchange security-related data, including information on breaches and temporary suspensions of access, through secure channels to ensure the proper functioning of the Union Registry and protect the personal data of account holders and authorized representatives.

The integrity of the data in the system has been evaluated high, as only very few incidents have led to inconsistencies in the data. One single major incident occurred during a database operation in 2022 due to human error. No confidentiality breaches such as data theft or accidental publication have been observed.

However, since 2012, the DG CLIMA has expressed concerns about IT security related the Union Registry in its Annual Activity Report. The European carbon market has experienced significant growth, with the total asset value in the Union Registry now exceeding EUR 200 billion. The carbon price has also been steadily increasing since 2014, rising from approximately EUR 6 to EUR 85 in 2022, and reaching a peak of EUR 100 in 2023. Furthermore, over the past decade, the regulatory environment for financial market institutions has undergone significant changes, and the risk of cyber-attacks from foreign states or hostile actors against the EU has increased. As a result, the IT risk landscape is evolving rapidly, necessitating additional security measures to mitigate these growing threats.

The 2019 risk assessment confirmed several vulnerabilities to be addressed in a ‘security plan’ involving 12 reinforcing security measures and the unusually high residual risk situation was escalated in September 2019 to the IT and Cybersecurity Board (ITCB) for advice. In addition, an independent study was commissioned in 2019 to benchmark the resources and operating model of the Union Registry against other institutions with comparable systems. The results highlighted significant weaknesses in terms of economic and human resources.

A subsequent study[301] was launched in December 2020 on potential alternative operating models for the Union Registry concluding that there was a pressing need to reduce the persistently high risks resulting from holding and handling high value assets that the current operating model fails to address.

A risk assessment was finalised in July 2022. It reconfirmed that the risk landscape had evolved in such a way that the 2019 measures even upon completion would not result in acceptable risk levels. A new security plan was proposed in 2022 that recommends finalising the

[300] According to Article 7(4) of Regulation 2019/1122, the central administrator and the national administrators shall agree on the terms of cooperation that shall include common operational procedures,

[301] Union Registry Operating Model Study, Deloitte

implementation of the measures from the previous plan (2019) and suggested 10 additional measures. Challenges to operate the system in the Commission internal governance structure facing the budgetary and HR constraints, remain. Therefore, a new business operating model is required to address thoroughly the remaining issues to reach highest compliance with applicable financial market frameworks.

The Union Registry's security framework has some strengths, such as the implementation of security measures and low incidence of data inconsistencies. However, the effectiveness of the Union Registry's security framework is compromised by the inadequacies in its operating model and the evolving IT risk landscape, which necessitate additional security measures and a new business operating model to mitigate the growing threats.

8.6.4.2 Efficiency

The efficiency of the Registry system is evaluated on the basis of the following question:

- EQ5: Are there significant differences in registry fees charged by Member States and if yes what is causing them?

Article 81(2) of the Registry Regulation stipulates that national administrators may charge reasonable fees to account holders administered by them. This gives national administrators considerable leeway in determining the fees. The fees charge by the national administrators are published on the Commission's website[302]. The fees vary with some countries charging no fees and others imposing substantially high charges for the opening, maintenance/management of accounts. Notably, several Member States, including Cyprus, Estonia, Finland, Germany, Malta, Netherlands, and Sweden, do not charge any fees for certain account types. In contrast, countries like Hungary, Latvia, Italy, and Poland have higher fees. For example, Hungary's trading account fee is EUR 5/tCO_2/year, and Portugal's fees range from EUR 107.24 to EUR 1,072.40 for different account types. Some Member States differentiate the fee based on the amount of verified emissions, such as Austria with fees ranging from EUR 450 to EUR 15 862; some also add a fee for changing name or authorised representatives of the account. For instance, Belgium charges a uniform fee of EUR 600.71 for all account types, whereas France has a tiered fee structure, with Operator Holding Accounts and Aircraft Operator Holding Accounts incurring fees between EUR 500 and EUR 3,500.Denmark's fees are in Danish Krone (DKK), with a range of 10,500 DKK to 350,000 DKK.

The structure and amount of the fee vary considerably across the Member States. The Registry Regulation provides a framework within which Member States can decide on the fees related to the registry services they offer. Each Member State has the autonomy to determine the specific structure and amount of these fees, resulting to variability across countries.

[302] https://climate.ec.europa.eu/eu-action/carbon-markets/eu-emissions-trading-system-eu-ets/union-registry_en#fees

Table 16: Overview of the fees[303]

Member State	Operator Holding Account	Aircraft Operator Holding Account	Trading Account	Verifier Account
Austria	EUR 450 - EUR 15,862	EUR 450 - EUR 15,862	EUR 1,700	EUR 0
Belgium	EUR 600,71	EUR 600,71	EUR 600,71	EUR 0
Bulgaria	EUR 100	EUR 100	EUR 175	EUR 50
Cyprus	EUR 0	EUR 0	EUR 0	EUR 0
Croatia	EUR 0	EUR 0	EUR 0	EUR 0
Czech Republic	EUR 47.62	EUR 47.62	EUR 59.52	EUR 0
Denmark	DKK14,000 - DK 350,000	DKK 14,000 - DK 350,000	DKK10,500	DKK7,200
Estonia	EUR 0	EUR 0	EUR 300	EUR 0
Finland	EUR 570	EUR 1620	EUR 570	EUR 570
France	EUR 500 - EUR 1250	EUR 500 - EUR 3,500	EUR 1,100- EUR 1,250	EUR 0
Germany	EUR 0	EUR 0	EUR 393	EUR 0
Greece	EUR 100 - EUR 300	EUR 300	EUR 300	EUR 0
Hungary	5/tCO_2/year	5/tCO_2/year	HUF 150,000/year	EUR 0
Iceland	ISK72200	ISK 72200	ISK72200	ISK72200
Ireland	EUR 350	EUR 350	EUR 1,000	EUR 0
Italy	EUR 400	EUR 400	EUR 700	EUR 500

[303] Overview of the fees charge by the Member States: the table does not reflect all the disparities regarding the fees; detailed information can be found on the website: https://climate.ec.europa.eu/eu-action/carbon-markets/eu-emissions-trading-system-eu-ets/union-registry_en

Latvia	EUR 95.70 - EUR 957	EUR 95.70 - EUR 957	EUR 803 - EUR 1,276	EUR 638
Liechtenstein	EUR 3,000	EUR 3,000	EUR 3,000	EUR 3,000
Lithuania	EUR 144	EUR 144	EUR 144	EUR 144
Luxembourg	EUR 500	EUR 500	EUR 500	EUR 0
Malta	EUR 0	EUR 0	EUR 0	EUR 0
Norway	NOK 9500	NOK 9500	NOK 9500	NOK 9500
Netherlands	EUR 0	EUR 0	EUR 400	EUR 0
Poland	PLN 2000	PLN 2000	PLN 2000	0
Portugal	EUR 375,34 - 750,68	EUR 375,34 - 750,68	EUR 1.072,00	EUR 857,92
Romania	EUR 200	EUR 200	EUR 300	EUR 250
Slovakia	EUR 500	EUR 500	EUR 625	EUR 0
Slovenia	EUR 100.15	EUR 100.15	EUR 50.07	EUR 0
Spain	EUR 575	EUR 575	EUR 805	0
Sweden	EUR 0	EUR 0	SEK 2000	EUR 0
United Kingdom (Northern Ireland)	£284	0	0	0

- EQ6: In what way the Union Registry has been operated cost effectively?

The annual costs to operate and maintain the Registry has been estimated at EUR 8 million. However, the studies on the Union Registry Operating Model underlined that the current economic and human resources are not sufficient to fully protect the confidentiality and integrity of the data held in the EUTL and the Union Registry. The European carbon market has experienced significant growth, with the total asset value in the Union Registry now exceeding EUR 200 billion, and the carbon price has been steadily increasing, making it an attractive target for cyber-attacks. Challenges in operating the system within the Commission's internal governance structure, facing budgetary and human resources constraints, remain. The studies informed that a new operating model would be required to thoroughly address the remaining issues and achieve the highest compliance with applicable financial market frameworks. An evaluation of the costs needed to have adequate infrastructure indicates that the proposed amount needed is EUR 30-40 million per year. This investment would be justified, as the cost of a proper infrastructure would represent only 0.00016% of the assets hold in the

Union Registry and would ensure the integrity and security of the system and the European carbon market. The creation of a new infrastructure would be essential to mitigate the growing threats and address the remaining issues, and the investment would be a critical step in maintaining the trust and stability of the European carbon market. The efficiency of the Union Registry, regarding the value of the assets, is linked to the creation and improvement of the IT infrastructure.

8.6.5 Conclusion

The evaluation of the Union Registry from 2018 to 2023 demonstrates its effectiveness in maintaining a reliable and secure IT system for tracking the creation, allocation, surrender, and reversal of allowances. The Registry operated efficiently, maintaining 99% uptime despite scheduled upgrades and minor technical issues, particularly in 2020. It successfully provides accurate, up-to-date, and publicly accessible information vital for ETS reporting, ensuring transparency and accountability while supporting compliance monitoring, market integrity, and informed decision-making. However, the Registry encounters challenges such as the limited LEIs, impacting financial supervisory capabilities, though integration is underway. Furthermore, while the security framework developed has protected data confidentiality and system integrity, emerging threats necessitate ongoing enhancements. The Registry's cost efficiency reveals significant fee variations across Member States and limitations in resources, which are crucial for system confidentiality and integrity. To address the evolving threats and resource constraints faced by the Union Registry, enhancements would be recommended. Studies suggest adapting security measures to meet increasing IT risks and market changes, ensuring the system's integrity remains robust. Strengthening the infrastructure security and revising the operating model would be necessary to align with financial market frameworks. Investment in a new operating model, estimated at EUR 30-40 million annually, would enhance these security measures without posing a significant financial burden, representing only 0.00016% of the assets held within the Registry. This investment would guaranty the overall security and integrity of the system and ensuring the credibility and reliability of the European carbon market.

8.7 Auctioning

8.7.1 Introduction

Since January 2013 auctioning is the default method for allocating allowances within the European Union Emission Trading System (EU ETS). The auctioning system plays a vital role in the EU ETS, enabling Member States to generate revenues while promoting a market-based approach to reduce greenhouse gas emission. Between 2015 and 2023, over 5 billion allowances were auctioned, generating more than 169 billion EUR.

The ETS Directive[304] establishes a regulatory framework for auctioning allowances. As of 2019, Member States are mandated to auction all allowances that are not allocated free of charge, with a share of 57% of allowances to be auctioned from 2021 onwards. The distribution of auctioned allowances among Member States is determined by a combination of factors, including historical emissions from installations covered by the ETS, with 90% of the total allowance volume allocated to Member States according to their verified emissions and 10% allocated to support solidarity, growth, and interconnections among Member States. The Directive ensures that revenues generated from the auctioning of allowances are reinvested in efforts to reduce greenhouse gas emissions and promote a low-carbon economy.

Pursuant to Article 10(4) of the ETS Directive, the Commission is empowered to adopt a delegated act that outlines the timing, administration, and other key aspects of the auctioning process. To ensure the integrity and effectiveness of this process, operators, and in particular small and medium-sized enterprises (SMEs) as well as small emitters covered by the EU ETS, must have full, fair and equitable access to the auctions and have simultaneous access to the same information. Additionally, the organisation and participation in the auctions should also be cost-efficient. The Auctioning Regulation[305] consequently complements these core requirements and establishes a robust framework for ensuring the transparency and efficiency of the auction process.

In 2018, the Auctioning Regulation was revised to align with the new EU ETS rules for the 2021-2030 period. The revised regulation introduced additional requirements namely the classification of EU ETS allowances as financial instruments under Directive 2014/65/EU[306] on markets in financial instruments (MiFID2). Those requirements strengthened the integrity of the carbon market by preventing market abuse, money laundering, and terrorist financing. New requirements have also been introduced for the determination of the annual auction volumes, which can be reduced by up to 3% in certain circumstances.

From 2021 the European Investment Bank (EIB) was appointed to auction allowances for the Innovation Fund and the Modernisation Fund. In addition, the auctioning system was sufficiently agile to make quick adjustments that allowed, as of July 2023, the auctioning of

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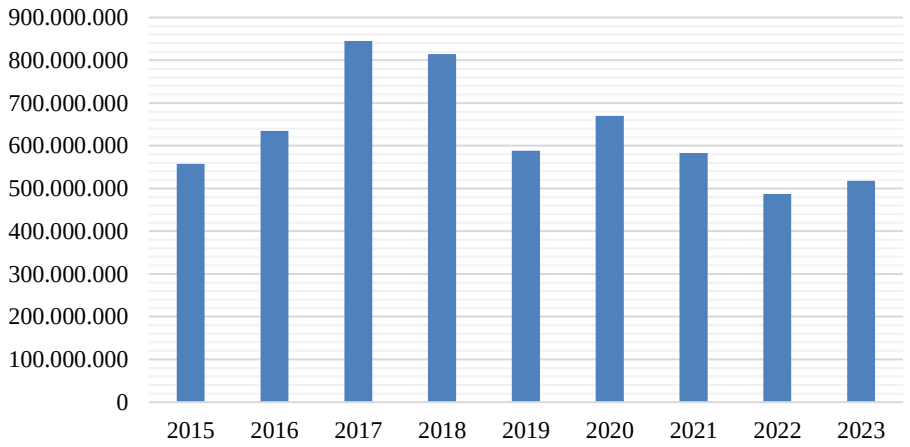
304 Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC (Text with EEA relevance)

305 Commission Regulation (EU) No 1031/2010 of 12 November 2010 on the timing, administration and other aspects of auctioning of greenhouse gas emission allowances pursuant to Directive 2003/87/EC of the European Parliament and of the Council establishing a scheme for greenhouse gas emission allowances trading within the Community Text with EEA relevance

306 Directive 2014/65/EU of the European Parliament and of the Council of 15 May 2014 on markets in financial instruments and amending Directive 2002/92/EC and Directive 2011/61/EU (recast) Text with EEA relevance

allowances to generate EUR 20 billion for the Recovery and Resilience Facility (RRF) under the REPowerEU Regulation (Regulation 2023/435)[307]

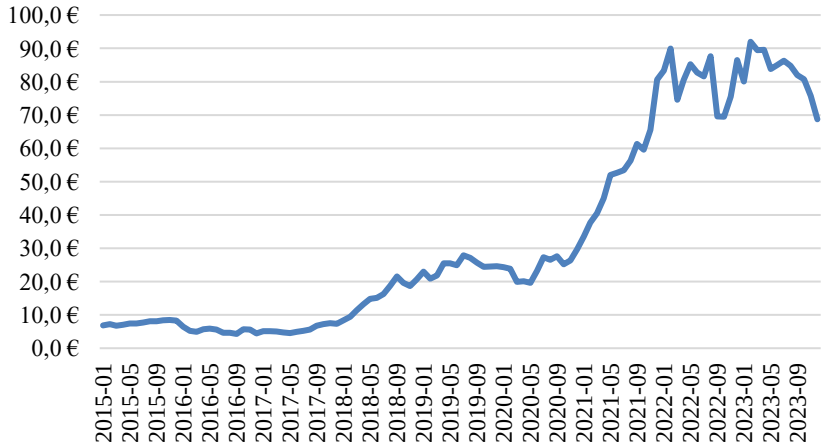
Figure 36: Volumes of allowances auctioned by EEX from 1 January 2015 to 31 December 2023



Source: EEX data, Own illustration

In 2018, the EU ETS auctioned 815 million allowances. Since 2019, with the introduction of the Market Stability Reserve (MSR), the auctions volumes are adjusted based on the surplus or deficit of allowances above or below pre-defined levels. This has stabilised the allowances market. Some surplus was observed in 2020 and 2021 during the COVID-19 pandemic. In that period, the drop in industrial production led to a decrease in the need of allowances. Other mechanisms such as the Linear Reduction Factor (LRF) have played a crucial role in stabilizing the allowances market. The increase in auctioned volume in 2023 reflects the additional volumes allocated to the Recovery and Resilience Facility (RRF) under the REPowerEU Regulation.

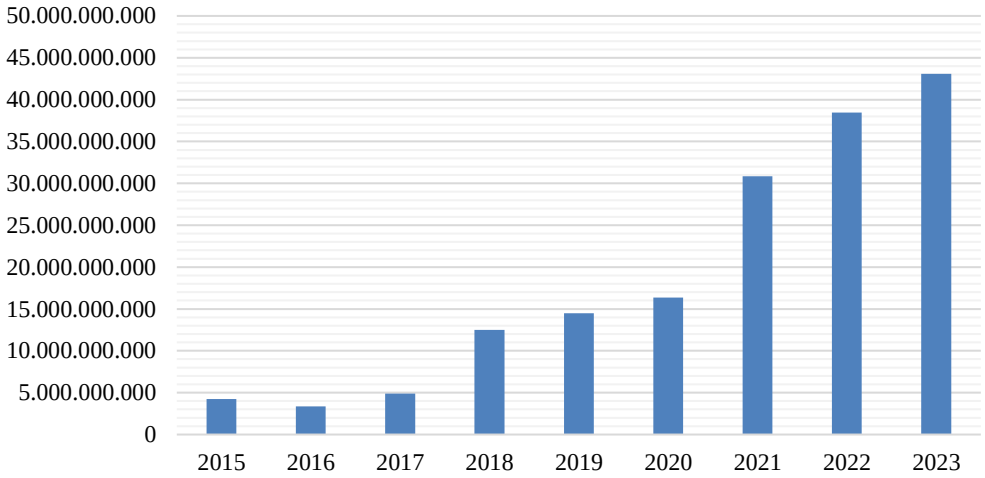
Figure 37: Evolution of the average monthly clearing price from 1 January 2015 to 31 December 2023



Source: EEX data, Own illustration

[307] Regulation (EU) 2023/435 of the European Parliament and of the Council of 27 February 2023 amending Regulation (EU) 2021/241 as regards REPowerEU chapters in recovery and resilience plans and amending Regulations (EU) No 1303/2013, (EU) 2021/1060 and (EU) 2021/1755, and Directive 2003/87/EC

Figure 38: Auction revenues from 1 January 2015 to 31 December 2023



Source: EEX data, Own illustration

The increase in EU ETS revenues between 2021 and 2023 can be attributed to a combination of factors, including higher clearing prices, increased auction volumes, and changes in the energy market. Indeed, the EU ETS Phase IV introduced several changes, including a more ambitious emissions reduction target (-61% by 2030 compared to 2005 levels) and a higher linear reduction factor (2.2% per year).

The substantial volume of allowances and resulting revenues generated through auctioning make it a critical component to assess within the EU ETS. Following up on the 2015 Evaluation of the ETS Directive, this evaluation focuses on the auctioning process, covering the period from January 2015 to 2023.

Auctions are used to allocate two types of allowances: European Union Allowances (EUAs) and Aviation Allowances (EUAAs). EUAs can be purchased by any entity and surrendered for compliance by stationary or aircraft operators, whereas EUAAs can be bought by any entity but can only be surrendered for compliance by aircraft operators. The volume and frequency of EUAA auctions are significantly lower than those of EUA auctions, primarily due to the scope of EUAAs, limited to the aviation sector. The high percentage of allowances allocated for free in the aviation sector and the reduced coverage of flights, as per Regulation 189/2014 (following the "stop-the-clock" Decision 2014/746), also contribute to this disparity. As a result, the conclusions drawn in this section primarily apply to EUA auctions, although they may also be relevant to EUAA auctions to the extent that they are auctioned on the same platform and follow the same rules and procedures.

Following the United Kingdom's withdrawal from the European Union, the UK's emissions are no longer part of the EU ETS. This evaluation will therefore exclude the allowances that were previously auctioned on the Intercontinental Exchange (ICE) platform for the UK.

This evaluation primarily considers the provisions outlined in the ETS Directive[308], in particular the principles of auction design listed in Article 10(4). According to these principles, auctioning should be designed to ensure that:

[308] The Auctioning Regulation is not a primary focus of this evaluation

- auctioning is conducted in an open, transparent, harmonised and non-discriminatory manner.
- operators, and any SMEs covered by the EU ETS, have full, fair and equitable access.
- all participants have access to the same information at the same time and that participants do not undermine the operation of the auctions.
- the organisation of, and participation in, the auctions is cost-efficient and undue administrative costs are avoided; and
- access to allowances is granted to small emitters.

The auction system has been in operation for several years. For the purpose of this evaluation, we focused on assessing its effectiveness and efficiency, as these aspects can be more readily measured. Other evaluation criteria, such as relevance and coherence, are more challenging to quantify and would require additional data or counterfactual scenarios. Therefore, our evaluation will primarily examine how well the individual components of the auction system are functioning and whether they are achieving their intended objectives.

8.7.2 Point of comparison

Provisions of relevance from the 2018 ETS Directive

Following the revision to the ETS Directive in 2018, several changes have been made that are relevant to the auctioning process. The changes concern the overall share of allowances to be auctioned, as well as their distribution to the Member States and to the Modernisation and Innovation Funds, established for Phase IV of the ETS. The main legal provisions are as follows:

- Article 10, paragraph 1 was amended as follows:

From 2021 onwards, and without prejudice to a possible reduction pursuant to Article 10a(5a), the share of allowances to be auctioned shall be 57 %.

- Article 10, paragraph 1, was amended as follows:

2 % of the total quantity of allowances between 2021 and 2030 shall be auctioned to establish a fund to improve energy efficiency and modernise the energy systems of certain Member States as set out in Article 10d (‘the Modernisation Fund’).

- Article 10a, paragraph 8, was added as follows:

325 million allowances from the quantity which could otherwise be allocated for free pursuant to this Article, and 75 million allowances from the quantity which could otherwise be auctioned pursuant to Article 10, shall be made available to support innovation in low-carbon technologies and processes in sectors listed in Annex I, including environmentally safe carbon capture and utilisation (‘CCU’) that contributes substantially to mitigating climate change, as well as products substituting carbon intensive ones produced in sectors listed in Annex I, and to help stimulate the construction and operation of projects that aim at the environmentally safe capture and geological storage (‘CCS’) of CO_2, as well as of innovative renewable energy and energy storage technologies; in geographically balanced locations within the territory of the Union (the ‘innovation fund’). Projects in all Member States, including small-scale projects, shall be eligible.

In addition, 50 million unallocated allowances from the market stability reserve shall supplement any remaining revenues from the 300 million allowances available in the period

from 2013 to 2020 under Commission Decision 2010/670/EU (5), and shall be used in a timely manner for innovation support as referred to in the first subparagraph.

- Article 10, paragraph 2 (a) was amended as follows:

The total quantity of allowances to be auctioned by each Member State shall be composed as follows: 90 % of the total quantity of allowances to be auctioned being distributed amongst Member States in shares that are identical to the share of verified emissions under the EU ETS for 2005 or the average of the period from 2005 to 2007, whichever one is the highest, of the Member State concerned;

- Article 10, paragraph 2 (b) was amended as follows:

10 % of the total quantity of allowances to be auctioned being distributed amongst certain Member States for the purposes of solidarity, growth and interconnections within the Union, thereby increasing the number of allowances that those Member States auction under point (a) by the percentages specified in Annex I.

- While the above provisions in the ETS Directive are relevant for determining the quantity and distribution of allowances to be auctioned, the main provision that lies at the basis of the detailed rules for the functioning of the auctioning system can be found in Article 10, paragraph 4 as follows:

The Commission is empowered to adopt delegated acts in accordance with Article 23 to supplement this Directive concerning the timing, administration and other aspects of auctioning, in order to ensure that it is conducted in an open, transparent, harmonised and non-discriminatory manner. To that end, the process shall be predictable, in particular as regards the timing and sequencing of auctions and the estimated volumes of allowances to be made available.

On the basis of the empowerment in Article 10(4) of the ETS Directive, the Commission developed and adopted the Commission Regulation (EU) No 1031/2010 of 12 November 2010 on the timing, administration and other aspects of auctioning of greenhouse gas emission allowances pursuant to Directive 2003/87/EC of the European Parliament and of the Council establishing a system for greenhouse gas emission allowances trading within the Union **(the Auctioning Regulation).** The main elements regulated in the Auctioning Regulation, are as follows:

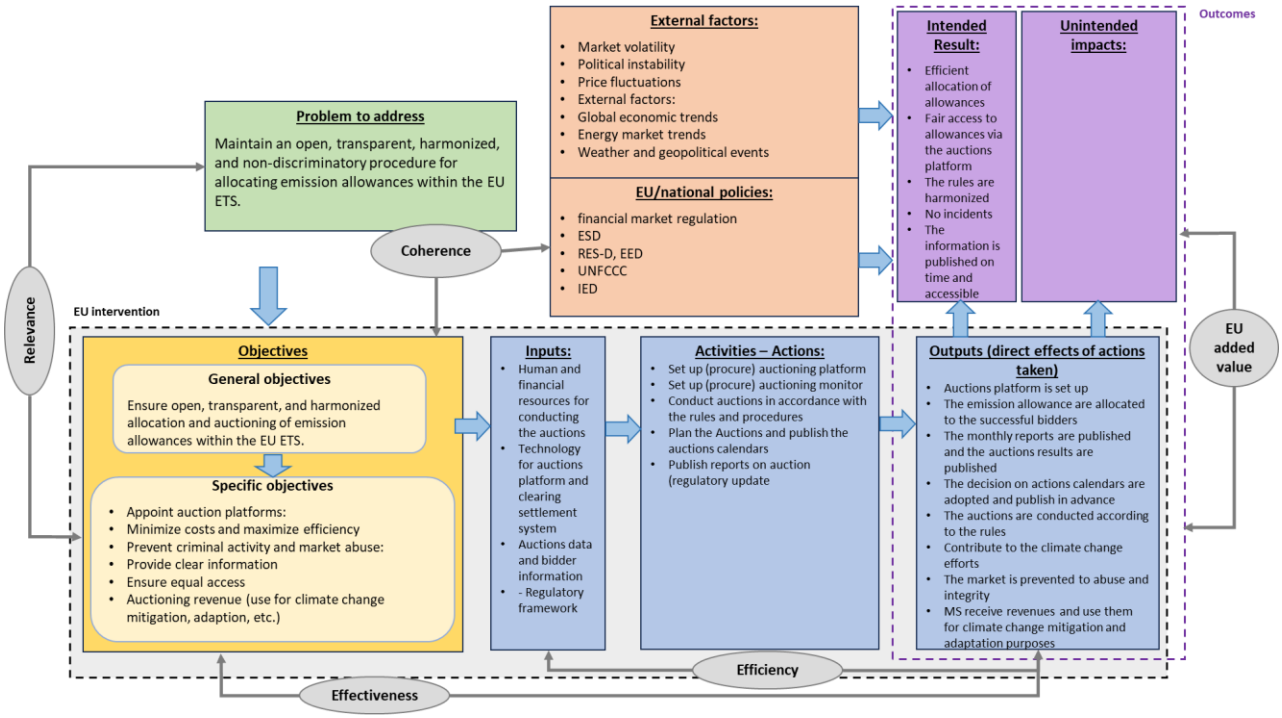
- the design of auctions (auctioned products, auction format, submission and withdrawal of bids, auction clearing price and resolution of tied bids).).
- auction calendars (timing, frequency and distribution of the volume of allowances, circumstances preventing auctions from taking place, annual volumes of auctioned allowances).).
- access to auctions.
- appointment of auctioneer(s) and related tasks.
- procedures for the cancellation of allowances.
- appointment of a common auction platform and services that the platform provides to Member States and the Commission.
- appointment and tasks of opt-out auction platforms (where a Member State does not participate in the appointment of the common auction platform).

During the evaluation period, the Auctioning Regulation was amended three times by:

- Commission Regulation (EU) 2017/1902 of 18 October 2017 amending Commission Regulation (EU) No 1031/2010 to align the auctioning of allowances with Decision (EU) 2015/1814 of the European Parliament and of the Council and to list an auction platform to be appointed by the United Kingdom.
- Commission Delegated Regulation (EU) 2019/7 of 30 October 2018 amending Regulation (EU) No 1031/2010 as regards the auctioning of 50 million unallocated allowances from the market stability reserve for the innovation fund and to list an auction platform to be appointed by Germany.
- Commission Delegated Regulation (EU) 2019/1868 of 28 August 2019 amending Regulation (EU) No 1031/2010 to align the auctioning of allowances with the EU ETS rules for the period 2021 to 2030 and with the classification of allowances as financial instruments pursuant to Directive 2014/65/EU of the European Parliament and of the Council.

8.7.3 Intervention logic

Figure 39: Auctioning Intervention logic



Source: Own illustration

8.7.3.1 Problem to address

Maintain an efficient allocation mechanism for allocating emission allowances

8.7.3.2 Objectives

The general objective is to ensure an open, transparent, harmonised and non-discriminatory auctioning allocation of emission allowances within the EU ETS. This is essential for the operation of the EU ETS as it distributes more than half of the quantity of ETS allowances (the share not allocated for free to installations at risk of carbon leakage) and creates the basis for the functioning of the carbon market and the formation of a carbon price.

A key part of this objective is to operationalise and implement the detailed provisions necessary to ensure the functioning of the auctioning system, reflected in the following specific objectives:

- **Appoint auction platforms:** the auction platform should be set up and function as intended, the auctions should be conducted according to the rules and procedures.
- **Minimize costs and maximize efficiency:** the auction process should be designed to reduce costs for participants and the auction platform, optimise the use of resources, minimise administrative burdens and ensure a smooth and efficient auction process.
- **Monitoring and preventing criminal activity, market abuse and ensure integrity**: the auction process should be monitored to prevent and detect criminal activities, market manipulation and abusive practices and ensure the integrity of the auction process and the EU ETS as a whole.
- **Providing clear and accessible information to participants**: ensuring that the participants have the necessary information to participate in the auctions and keeping them informed about the auction process and results.
- **Participants:** ensuring that all eligible participants, in particular SMEs and small emitters, have equal access to the auction process and a clear understanding of the auction rules and procedures.
- **Auctioning revenue use:** the revenues generated from the auctions should be used in accordance with the Directive.

8.7.3.3 Inputs

The successful implementation of the auctioning system depends on several key inputs:

- the issuance of allowances is crucial, as it determines the quantity of units to be auctioned and provides a foundation for the entire process.
- sufficient human and financial resources to procure the auction platform is essential for conducting the auctions efficiently and effectively as well as the collaboration with the national competent authorities.
- a reliable technology infrastructure, including a robust auction platform and clearing settlement system, is also vital to ensure the smooth operation of the auctions.
- access to accurate and timely auctions data, as well as information, is necessary to monitor the auction process and make informed decisions.
- a well-defined regulatory framework is required to provide a clear and stable environment for the auctioning system to operate, outlining the rules, guidelines, and standards that govern the auctions and ensuring their integrity and transparency.

8.7.3.4 Actions

A series of targeted actions have been taken to strengthen the auctioning system and to enhance the efficiency and transparency:

- settings up a reliable auction platform and IT system to facilitate smooth transactions.
- developing and implementing a robust legal framework that outlines the auction process, bidder eligibility and conducting auctions in strict conformity to predefined rules and procedures.
- ensuring access to auctions for all eligible participants and provide regular training to the bidders.

- the auction process is closely monitored and overseen to prevent any irregularities and maintain the integrity of the system and the allowances have been classified as financial instruments.
- planning auctions in advance, including the publication of auction volumes and calendars, provides clarity and predictability for participants.
- publishing detailed reports on auction outcomes and providing ongoing information about the auction process.

8.7.3.5 Outputs

The implementation of these actions has yielded several important outputs that contribute to the overall functioning of the auctioning system:

- the auction platform has been successfully set up, and operates as intended, providing a reliable and efficient environment for conducting auctions.
- all auctions have been conducted in accordance with the established rules and regulations, ensuring fairness, transparency, and integrity throughout the process.
- the system has ensured that all eligible participants have equal and unhindered access to the auctions.
- measures have been in place to prevent market abuse, ensuring the integrity of the auction process and maintaining trust among participants.
- emission allowances have efficiently allocated to the successful bidders following each auction.
- decisions on auction calendars have been made and published well in advance, providing clarity and predictability for all stakeholders.
- comprehensive monthly reports and detailed results of each auction have been published, ensuring transparency and accountability.
- Member States have received revenues generated from the auctions and utilise these funds for initiatives aimed at mitigating the effects of climate change and adapting to its impacts.

8.7.3.6 Intended results and impacts

The intended outcomes of the auction system are an efficient allocation of allowances that provides a transparent and non-discriminatory process, ensuring that all participants have equal access to allowances. The auctions system should continue to promote fairness. The auction platform has operated under a set of harmonised rules, ensuring consistency and coherence across all Member States. The auction system should ensure that the significant revenues received by the Member States from the auctioning of allowance are used to support climate change mitigation and adaptation efforts. The auction platform should operate smoothly and without incidents, ensuring that the allocation of allowances is not disrupted, and that the integrity of the system is maintained. It provides timely and publicly available information on auction results, allowance prices, and other relevant data. This increases transparency, facilitates market analysis, and enables stakeholders to make informed decisions.

8.7.3.7 Unintended results and impacts

The auction system, designed to promote efficient allocation allowances and reduce emissions, can have several unintended consequences that affect it like the market, politics, and the environment. Firstly, volatility uncertainty and speculation among bidders can lead to overbidding or underbidding based on expectations of market conditions. Additionally, information asymmetry, where bidders have varied levels of market knowledge, can create

uneven competition and further contributing to volatility. Political instability can also emerge while the implementation and management of the auction system require a robust regulatory framework. Another unintended result can be the fluctuation in prices, making difficult for market participants to plan investments. Significant price fluctuations can lead to windfall profits for some participants. Besides, high prices can increase the production costs for companies operating within the auction system, making them less competitive and lead to carbon leakage.

8.7.3.8 External factors

Various external factors over the past years, such as the economic crisis and subsequent recovery, have impacted the demand for allowances, with lower economic activity leading to reduced emissions and lower prices. Energy market trends, including fluctuations in gas and fuel prices, affect the competitiveness and the demand for allowances. Additionally, weather conditions, such as mild winters or hot summers, have influenced energy demand and, consequently, emissions levels, affecting the auction prices. Geopolitical events, including the COVID-19 pandemic, led to reduced economic activity and lower emissions.

8.7.3.9 Data collection

The evaluation findings are based on desk research based on several reports, such as:

- the reports prepared by the Commission on behalf of the participating Member States pursuant to Article 10(4) of the ETS Directive.
- the ESMA report: 'Report on Emission Allowances and associated derivatives'.
- the Carbon Market Reports prepared by the Commission pursuant Articles 10(5) and 21(2) of the ETS Directive.
- the report by Europe Economics on the 'Analysis of the functioning of the EU Carbon Market and the recent market developments'.
- the report by Europe Economics on 'Participation in the EU ETS markets'.
- auction results and reports from the auction platform EEX.

8.7.4 Evaluation of findings

8.7.4.1 Effectiveness

The **effectiveness** criterion evaluates how successfully the EU ETS auctioning system has fulfilled its objectives of ensuring an open, transparent, harmonised and non-discriminatory auctioning allocation of emission allowances within the EU ETS.

The criterion is evaluated based on the following evaluation question:

- EQ1: To what extent has the auctioning system achieved its general objective of ensuring open, transparent, harmonised, and non-discriminatory allocation of emission allowances?

Auctions have been conducted in an open and transparent manner.

The rules and procedures governing the auctions, including timing, format, and participation requirements, are clearly defined and made publicly available on the EEX and European Commission websites. Entities willing to participate in auctions must comply with eligibility

criteria[309] which guarantee the integrity of the auction process and a fair and open access for all auction participants[310].

The auction platform provides participants with transparency and predictability: auction volumes and calendars are published in advance, allowing potential bidders to plan and prepare for upcoming auctions. Following each auction, the results are publicly disclosed on the EEX website, including the clearing price and volume of allowances sold, which ensures not only transparency but also accountability within the system.

The EU ETS provides a harmonised framework for auctioning allowances across all Member States, ensuring consistency and coherence in the allocation of allowances. All Member States used the common auction platform operated by EEX, either through joint action or as the opt-out platform, with the same auctioning rules applied equally to all Member States and EFTA countries. Moreover, the European Commission and national authorities coordinate and oversee the auctioning process, ensuring that the system operates in a harmonised and effective manner.

The European Securities and Markets Authority (ESMA) has released a report[311] on '*Emission allowances and associated derivatives'*. The report provides evidence supporting the conclusion that the auction market is functioning effectively, with the auctioning process performing as expected. One of the drawbacks could be the concentration of a few large participants dominating the primary markets, but the report highlighted that these same players are also active in the secondary market. This fosters the distribution of allowances to a wider range of market participants. Overall, ESMA's findings suggested that the European carbon market is operating normally, with no major abnormalities or fundamental issues detected.

- EQ2: Is the auction platform set up and functioning as intended, and are the auctions conducted according to the rules and procedures

The auction platform is functioning as planned and the auctions are conducted according to the rules and procedures.

In 2016 European Energy Exchange (EEX), based in Leipzig, has been appointed as common auction platform (the second common auction platform or CAP2) pursuant to Article 26(1) of the Auctioning Regulation for 25 Member States participating in a joint procurement

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309 Articles 18 and 19 of Regulation 1031/2010 on the timing, administration and other aspects of auctioning of greenhouse gas emission allowances (the Auctioning Regulation)

310 The following persons are eligible to apply for admission to bid directly in the auctions: operators with compliance obligations (including other subsidiaries of the same group of undertakings as the operator with compliance obligations), investment firms authorised under Directive 2014/65/EU, credit institutions authorised under Directive 2013/36/EU, business groupings of compliance operators bidding on their own account and acting as agent on behalf of their members, public bodies that control any compliance operator, and persons covered by the "ancillary activity exemption" of MiFID II when the Member State where they are established has enacted legislation enabling the "relevant competent national authority" in that Member State to authorise them to bid on their own account or on behalf of clients of their main business.

311 In its Communication on Energy Prices "Tackling rising energy prices: a toolbox for action and support" published on 13 October 2021, the European Commission highlighted that questions have emerged around the functioning of the European carbon market. To examine more closely patterns of trading behaviours and the potential need for targeted actions, the Commission asked ESMA for a first preliminary assessment of European carbon markets by 15 November 2021 and asked it to analyse, by early 2022, the trading of emission allowances. In its report, ESMA has analysed the data regarding emission allowances gathered from different sources, including EMIR reporting, MiFIR transaction reporting, MiFID II daily and weekly position reports, auction data and data obtained from the EU Registry.

procedure. Poland concluded an agreement with EEX to make use of the CAP to auction its share of allowances in the absence of listing of its auction platform. EEX also auctions for Germany as an 'opt-out' auction platform. Iceland, Liechtenstein and Norway have started to auction allowances in June 2019, after the EEA Agreement was amended to allow them to participate in the in the Joint Procurement Agreement for the common auction platform.

In May 2020, the Commission launched a procurement procedure to appoint the third common auction platform (CAP3). EEX was appointed as the common auction platform to conduct auctions on behalf of 28 Member States[312] as well as the auction platform for Poland and Germany. The CAP 3 contract was signed in November 2020 and the first auctions under CAP3 started in February 2021. No auctions have been conducted in January 2021 due to the transitional period between CAP2 and CAP3. The contract covers the first period of Phase IV (2021-2025).

The Leipzig-based exchange now runs the single-round, sealed-bid, uniform-price auctions of allowances in the form of spot products, with auctions of general allowances occurring three days per week for the CAP, once a week for Germany and every other week for Poland. Auctions of aviation allowances occurring less frequently. The hand-over and transfer of responsibilities from the CAP2 to CAP3 was executed smoothly with only a minimum delay of a few weeks in the resumption of auctions in 2021 in order to put in place all the necessary administrative and technical arrangements under the new contract, such as new auctioneer agreements, developing a new reserve price methodology, etc.

The conduct of the auctions requires the implementation of a collaborative process. The calculation of the auction volumes and the preparation of auction calendars involve multiple stakeholders, including the European Commission, the auction platform, and Member States via the Joint Procurement Agreement. This process consists of several steps that ensure the accurate computation of the auction volumes, considering all requirements and provisions of the legislation[313]. The procedures put in place ensured that errors were avoided and that the volumes to be auctioned were correctly calculated and decisions were adopted in a timely manner. Although calendars were typically published on a regular schedule between 2018 and 2022, a small delay occurred during the transition period from CAP2 to CAP3.

To illustrate the good functioning of the auctioning system, to date over 3000 auctions have been held (for all auction platforms) and only 12 auctions have been cancelled, representing less than 0.5% of the auctions. Cancellations of auctions are necessary in order to ensure the integrity of the auctions, such as if the minimum set reserve price is not met, or if there are not enough bids to cover the full amount auctions. Disruptions to the auction process due to technical incidents or other issues can also lead to a cancellation.

- EQ3: Have the calculations of the auction volumes taken into account all the requirements of the provisions?

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312 25 EU Member States, Iceland, Liechtenstein and Norway.

313 The calculation of auction volumes considers the intakes to, or releases from the MSR as well as Articles 10c,10d, 27 and 27a of the ETS Directive. Once the auction volumes are calculated, EEX is informed and creates draft auction calendars and tables, which are then verified by the Commission to ensure compliance with regulatory requirements. The draft auction calendars are approved by the Joint Procurement Steering Committee (JPSC), after which the Commission adopts a decision on the auction volumes and calendars. On average, two decisions are adopted within a year: one in December for the calendars of the following year, and another in July, adjusting the calendar of the current year, considering the MSR and the volumes of the following year.

EEX has regularly published on its website the auction calendars in coordination with the European Commission, the EU Member States and the EEA EFTA States auctioning on the common auction platform as well as with the competent authorities of Germany and Poland and the United Kingdom on behalf of Northern Ireland. The calendars reflect the planned amounts of allowances to be sold at each auction and are published several weeks in advance. Each year in July, the auction volumes are adjusted for the period from September to December in accordance with the Auctioning Regulation due to the operations of the MSR. Auctions on the common auction platform take place on Mondays, Tuesdays, and Thursdays. The auctions on behalf of Germany were conducted by EEX on Fridays, while the auctions on behalf of Poland were scheduled bi-weekly on Wednesdays. During the two-hour bidding windows, the entities admitted participating can submit their bids. Winning bidders receive allowances delivered in their accounts in the Union Registry[314]. The success of a bid depends on the price and the number of allowances auctioned. Article 7 of the Auctioning Regulation specifies how the auction clearing price is determined.

The European Commission publishes detailed auction reports on a quarterly basis on its website. The reports are prepared in collaboration with the participating Member States and Poland, based on information provided by the common auction platform, in accordance with Article 10(4) of the ETS Directive. Germany also publishes auction reports regularly based on data from its opt-out platform. The auction results published in those reports show that the auctioned volumes were indeed purchased by the winning bidders.

The volumes were distributed evenly over the scheduled auctions, as specified in the Auctioning Regulation.

- EQ4: Are the auction results published in a timely and accessible manner, and do they provide sufficient information to participants and stakeholders?

The auction results have been published in a timely and accessible manner, and the participants and stakeholders have been provided all the necessary information.

In accordance with the transparency requirements set forth in the Article 61 of the Auctioning Regulation the auction platform publishes detailed auction results no later than 15 minutes after the close of the bidding window. Throughout the evaluation period, full compliance with the specified requirements was maintained, and no deviations or discrepancies were observed. Furthermore, the auction platform submitted and continues to submit a monthly report to the Commission, by the fifteenth day of each calendar month, as stipulated in the CAP contract. The report served as the basis for the publication of a quarterly report prepared by the Commission on behalf of the Member States participating in the joint action and Poland in accordance with Article 10(4) of the ETS Directive. The German auction platform also publishes a quarterly report. The most recent auction report for CAP3 presents the results of the second quarter of 2025. Although this can be considered as a timely publication, the date of publication must be indicated on the website to properly monitor the timely publication of the reports.

[314] From an operational perspective, two parallel processes are to be distinguished. Firstly, at the level of the Union Registry, allowances are transferred from the Auction Account to the successful bidder's account in the Registry, via the Auction Collateral Delivery Account of ECC, the central counterparty. Secondly, at the level of ECC, winning bidders pay the auction proceeds to the auctioneers of the Member States.

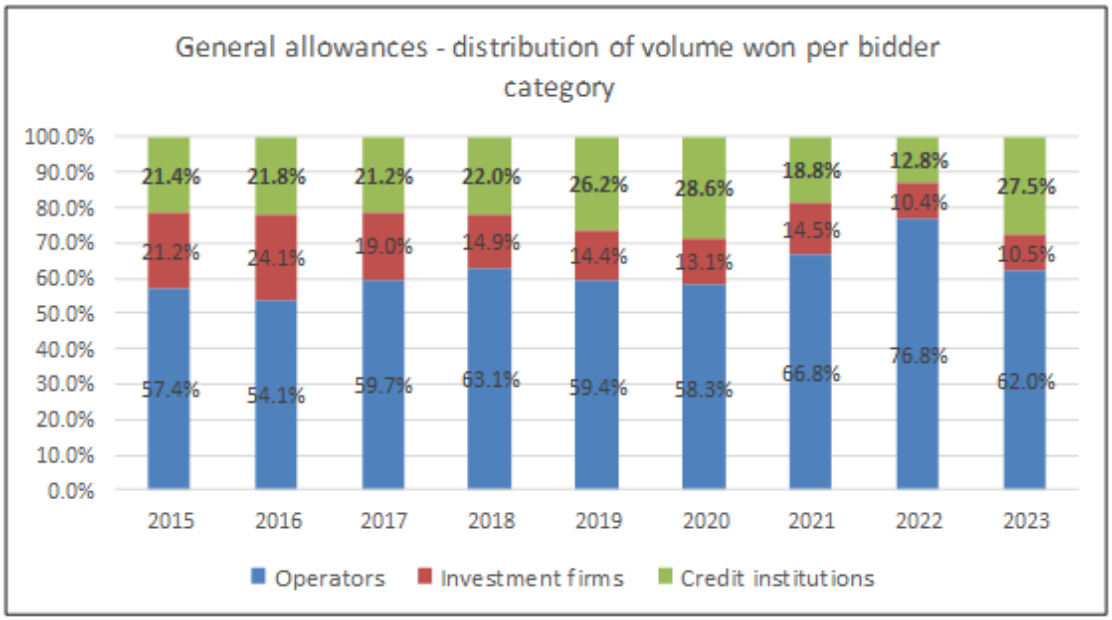
- EQ5: To what extent does the auctioning system ensure equitable access to allowances for all eligible parties, including SMEs and smaller emitters?

The auctioning system has ensured an equitable access to allowances for all eligible parties, including SMEs and smaller emitters.

The European Union Allowance (EUA) auctions have a relatively small number of participants; 117 bidders are registered with 48 unique entities participating in 2021, consisting of 34 non-financials and 14 financials.

The auction reports show the distribution of successful auction volume won between operators, investment firms, and credit institutions. As displayed in figure below, operators won most of the allowances (62% on average between 2015 and 2023). Investment firms and credit institutions play an important role in the secondary market. They act as intermediaries and market makers and facilitate the trading of emission allowances and allowance derivatives for the compliance entities in the secondary market. As ESMA concluded in its report, while the auction market is somewhat concentrated, the largest participants are also active in the secondary market and ensure that the auctioned allowances are disseminated to other secondary market participants.

Figure 40: General allowances - distribution of volume won per bidder category



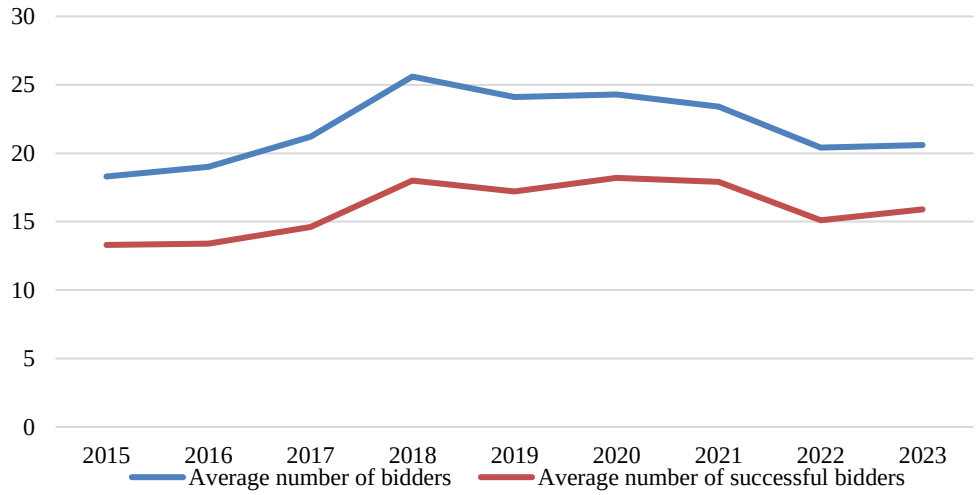
Source: EEX auction report

Figure 41 below illustrates a relatively stable trend in the number of bidders per auction, with a narrow fluctuation range between 18.3 bidders per auction in 2015 and a peak of 25.6 in 2018. This peak can be attributed to the revision of the ETS, which introduced measures aimed at stimulating participation in the carbon market. Over the 2015-2023 period, the average number of bidders showed a small increase of 12.4% (from 18.3 to 20.6), indicating a gradual expansion of market engagement. Notably, the number of successful bidders closely tracks the trend in overall bidders, suggesting a consistent level of competitive participation in the auctions.

Furthermore, Figure 42 shows that subscription to ETS auctions have been stable over time with a cover ratio, i.e. the volumes of bids submitted vs the volume of allowances auctioned between 1.5-2. A cover ratio under 1 would result in the cancellation of the auction, while a

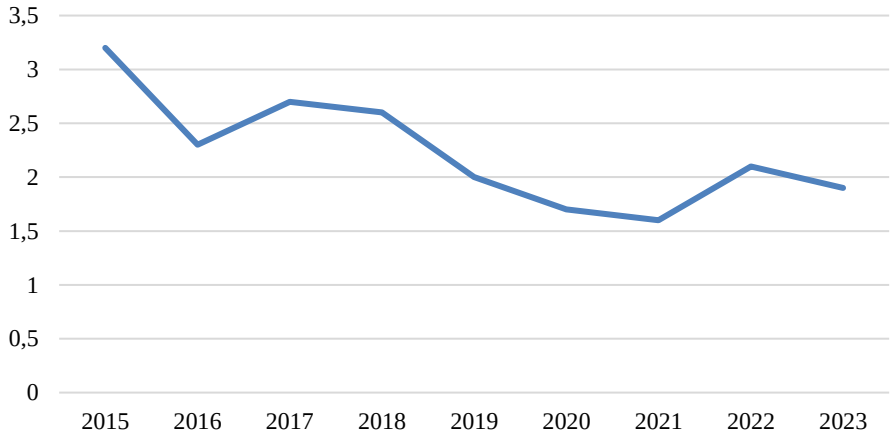
cover ratio significantly above 2 would mean that auctions are oversubscribed and a significant share of bidders would not be able to be successful in their bids. Therefore, a cover ratio of around 1.5 shows the healthy balance between the demand and supply for allowances in the ETS auctions.

Figure 41: Evolution of number of bidders in ETS auctions (participating and successful)



Source: EEX data, own illustration

Figure 42: Annual average cover ratio[315] in EUA auctions held at EEX between 2015-2023



Source: EEX data, own illustration

The top 10 auction participants are significant players in the secondary market, holding a substantial portion of allowance derivatives positions and acting as large net suppliers of physical allowances to other market participants and compliance entities. Indeed, analyses provided by ESMA, show that SMEs and small emitters prefer to cover their allowance needs through intermediaries and to avoid the learning curve and the costs associated with establishing their eligibility for auction participation and obtaining electronic-based access to the auction.

[315] Cover ratio is the ratio between the total bid volume and the auction volume.

According to the report from Europe Economics, 'Participation in the EU ETS markets'[316] The current system of acquiring allowances is functioning well, with firms not experiencing significant barriers to participation or feeling exploited by other economic agents. As a result, they rely heavily on financial institutions to acquire allowances. This dependence on financial entities is particularly prevalent among SMEs, but it also applies to larger firms with limited needs for allowances. The compliance entities reported that it is a convenient arrangement that saves them from having to develop their own expertise. Any lack of direct participation in auctions by SMEs and small emitters cannot be characterised as a failure on behalf of the regulator to ensure fair auction access specifically to these entities.

The evaluation on this point concerns the degree of effort made by the Commission and auctioning platform to inform and involve smaller emitters. That degree of effort is high, with the EEX offering since mid-2012 an "auction-only" (Figure 43) exchange membership category that exempts participants from obligations applying to larger exchange members. Auction reports for CAP2 and CAP3 auctions specify the number of such auction-only participants: between 2016 and 2023 the average number of "auction-only bidders" per month is four. Thus at least some (possibly) smaller firms have taken advantage of this option. EEX also offered regular training sessions and conferences to encourage and support the participation of SMEs in the primary market.

Figure 43: Auction only participants

Number of participants		Operator		*Investment firm*	*Credit Institution*	*Business grouping*	*Person exempt from MiFID requirements*	Total
		Stationary	Aircraft					
Auction-only access	Dec 16	2	-	1	-	-	1	4
	Dec 17	2	-	1	-	-	1	4
	Dec 18	1	-	-	-	-	1	2
	Dec 19	1	-	-	-	-	1	2
	Dec 20	2	-	-	-	-	1	3
	Dec 21	3	-	-	-	-	1	4
	Dec 22	2	-	2	1	-	1	6
	Dec 23	2	-	2	1	-	1	6

Source: EEX monthly reports

- EQ6: Has the auctioning system prevented market manipulation and abusive practices, ensuring the integrity of the EU ETS?

The auctioning system has prevented market manipulation and abusive practices and ensured the integrity of the EU ETS.

Since 2018, the MiFID II Directive has classified allowances as financial instruments. By requiring trading venues to report transactions to their national competent authority, MiFID II has contributed to the integrity of the EU ETS. MiFID II also requires trading venues to establish arrangements, systems, and procedures to detect and report suspicious orders and transactions. As financial instruments, the allowances fall within the scope of the Market Abuse Regime (MAR). MAR aims to promote market integrity by prohibiting insider dealing, unlawful disclosure of inside information, and market manipulation. To achieve this, MAR provides rules for issuers, intermediaries, and trading venues to follow, as well as powers for

[316] https://climate.ec.europa.eu/document/download/6496c9a4-a4b3-4259-8908-466f8356aa31_en?filename=policy_ets_integrity_report_participation_en.pdf&prefLang=fi

competent authorities (NCAs) to detect and prosecute breaches. EEX also provides a framework for market oversight shared between the management board and the market surveillance office of the exchange platform. The market surveillance office is an independent pillar of the public exchange and by law a public authority. It must collect and analyse all trading, reporting and clearing data daily. The auction reports provided by EEX to the European Commission include data on bidding behaviour, market trends, and other relevant information. Since the introduction of MAR, EEX has not detected any suspicious activity or market manipulation in the auctions (primary market) or in allowance derivatives (secondary market). MAR, combined with the market oversight activities of EEX and the reporting requirements under the Auction Regulation, provides a robust framework to prevent any wrongdoing.

8.7.4.2 Efficiency

The efficiency criterion is meant to assess costs associated with auctioning and whether they have been justified, given the cost-saving effects auctioning has achieved. Since the alternative to auctioning is free allocation, the efficiency criterion in this case asks in what ways auctioning has been more cost-effective than free allocation and to what extent inefficiencies have been observed.

The efficiency of the EU ETS auctioning system is assessed through the following evaluation questions:

- EQ8: In what ways has auctioning been more cost-effective than free allocation?

Overall, the goal of the efficiency criterion is to determine whether auctioning has been a successful and effective way to allocate resources, and to identify areas for improvement in the future.

Literature review and analyses provide some evidence. Auctioning is considered the most efficient way for allocating allowances, as it provides a market-based approach to allocation and allows for a more efficient distribution. According to the study 'Emissions trading with transaction costs' by Marc Baudry, Anouk Faure, and Simon Quemin[317], auctioning can help to reduce the risk of over-allocation and windfall profit and ensure that allowances are allocated to those who value them the most. Additionally, auctioning can generate revenues for governments, which can be used to support climate change mitigation and adaptation efforts. As noted by authors such as Gbenga Adamolekun in 'Carbon price and firm greenhouse gas emissions[318]', auctioning can lead to a greater reduction in greenhouse gas emissions compared to free allocation.

The use of auctioning as an allocation method has been shown to be effective in reducing emissions and increasing investment in abatement measures. Authors such as Frank Maarten and Jan Venmans in 'The effect of allocation above emissions and price uncertainty on abatement investments under the EU ETS[319]' suggest that auctioning can provide a stronger incentive for companies to invest in abatement measures and reduce barriers to investment. Furthermore, auctioning can help to reduce market manipulation and increase transparency,

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317 Marc Baudry, Anouk Faure, Simon Quemin, Emissions trading with transaction costs, Journal of Environmental Economics and Management, Volume 108, 2021, 102468, ISSN 0095-0696, https://doi.org/10.1016/j.jeem.2021.102468.

318 Gbenga Adamolekun, Carbon price and firm greenhouse gas emissions, Journal of Environmental Management, Volume 349, 2024, 119496, ISSN 0301-4797, https://doi.org/10.1016/j.jenvman.2023.119496.

319 Frank Maarten Jan Venmans, The effect of allocation above emissions and price uncertainty on abatement investments under the EU ETS, Journal of Cleaner Production, https://doi.org/10.1016/j.jclepro.2016.02.108.

which are essential for a well-functioning emissions trading scheme. As noted by Jan Abrell, Johanna Cludius, Sascha Lehmann, Joachim Schleich, and Regina Betz in 'Corporate Emissions-Trading Behaviour During the First Decade of the EU ETS[320]', auctioning can increase companies' ability and willingness to actively participate in emissions trading, thus increasing efficiency.

In practice, the administrative time and resource involved in setting benchmarks and determining free allocation amounts by assessing National Implementing Measures (NIMs) is eliminated to the extent that auctioning is used. It is challenging to precisely measure the cost savings of auctions in the EU ETS, as auctions are not the only method of allocation. Instead, they are compared to a scenario where free allocation is the sole method. Auctioning is the default method, but free allocation still occurs, particularly outside the power sector. Auctioning requires additional administrative and financial resources, including selecting the auction platform, overseeing the auction process and managing associated procedures and reports. However, the cost savings from auctioning are due to increase, as the percentage of the total allowances freely allocated declines.

In contrast to the above-described costs to regulators, costs to auction participants are higher than under free allocation (leaving aside the costs for baseline data collection and verification). Buying allowances rather than getting them for free is of course more expensive. One must also add the cost of participating in the auctions and trading on the auction platform. Entities wishing to participate in the auctions must pay a registration fee to the auction platform. Besides, fees[321] per lot of allowances won in auctions are equivalent to those on the secondary market (currently 2 EUR per lot of 500 allowances). Power sector players regularly trade electricity products in addition to being active on the secondary market for emissions allowances. They are therefore very likely to have paid the requisite fees already. However, for SMEs those fees may constitute an effective barrier to participate in auctions. They may find it more economical to access the auctions via intermediaries or to obtain allowances in the secondary market.

- EQ9: Have there been significant structural premiums or discounts on auction prices, compared to secondary market prices?

There have not been any significant structural premiums on auction prices compared to the secondary market.

Each auction report for each month from 2020 to 2022 state that 'the auction clearing price was in line with the price signal in the secondary market'. The CAP reports compare the auction clearing prices with the secondary market price for spot emission allowances. The differences

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320 Sascha Lehmann, Joachim Schleich, "Does increasing auctioning in the EU ETS increase companies' search efforts for favourable trading options?", Journal of Environmental Management, Volume 387, 2025, 125830, ISSN 0301-4797, https://doi.org/10.1016/j.jenvman.2025.125830.

321 The EEX market participants have five options to participate in auctions, with four options offering direct access and one option providing indirect access via intermediaries. The fees for direct access vary depending on the membership model, with new trading participants not being charged annual fees for the first 12 months. The yearly costs range from EUR 0 for auction-only membership to EUR 37,000 for trading all products on all EEX markets. Additionally, a maximum fee of EUR 1,000 per year may apply for the Clearing House ECC, but only if a participant trades very little or nothing. In contrast, the terms and conditions for indirect access need to be agreed upon with the intermediary, and the fees are not explicitly stated. Regardless of the option chosen, companies must meet the eligibility criteria in accordance with Article 18 of the Auctioning Regulation and fulfil specific requirements, such as having a contract with a clearing member and liable equity of EUR 50,000, depending on the membership option.

were small, ranging from EUR 0.05 to 0.63, with most values between EUR 0.10 and 0.40. The German annual auction reports even include tables illustrating the relationship of EUA spot auction clearing prices to secondary market prices over time, as illustrated in the table below. In 2022, the maximum deviation was EUR 0,62 (in April).

Figure 44: EUA-Auctions and deviations from secondary market prices in 2022 (Germany)

Date	Contract	Clearing price	Deviation from secondary market	
			Absolute	%
January	EUA Spot 4th TP	*€ 84.93	€ 0.21	0.25%
February	EUA Spot 4th TP	*€ 89.80	€ 0.15	0.17%
March	EUA Spot 4th TP	*€ 75.36	€ 0.39	0.52%
April	EUA Spot 4th TP	*€ 82.12	€ 0.62	0.76%
May	EUA Spot 4th TP	*€ 86.89	€ 0.36	0.41%
June	EUA Spot 4th TP	*€ 82.21	€ 0.43	0.53%
July	EUA Spot 4th TP	*€ 82.12	€ 0.38	0.45%
August	EUA Spot 4th TP	**€ 89.56	€ 0.43	0.47%
September	EUA Spot 4th TP	*€ 69.81	€ 0.39	0.55%
October	EUA Spot 4th TP	*€ 70.97	€ 0.26	0.36%
November	EUA Spot 4th TP	*€ 75.76	€ 0.25	0.33%
December	EUA Spot 4th TP	**€ 85.63	€ 0.35	0.41%
Mean absolute deviation			**€ 0.35**	**0.44%**

Source: ICE, EEX, Refinitiv Eikon, DEHSt
* Average
** Volume-weighted average
*** ICE EUA Daily Future/EEX EUA Spot

Source: German Emissions Trading Authority (DEHSt) - German Auctioning of Emission Allowances report

- EQ10: To what extent has the auctions system demonstrated agility in responding to changing requirements and generating revenue?

The auctions system has demonstrated significant agility in responding to changing requirements and generating revenue to reduce greenhouse gas emissions.

Since 2015, several changes have been made to align the auctioning of allowances with the EU ETS rules, including the establishment of a market stability reserve, the introduction of new funds such as the Modernisation Fund and the Innovation Fund, and the adaptation of auctioning rules to support climate change mitigation and adaptation efforts.

The system has also been modified to increase the share of allowances to be auctioned, with 57% of allowances to be auctioned from 2021 onwards, and to allocate 2% of the total quantity of allowances to the Modernisation Fund. Furthermore, the system has been adapted to provide a 3% buffer for free allocations, ensuring that the auctioning share is respected while also allowing for flexibility in the allocation of allowances. The operation of the MSR has contributed to a significant increase in the carbon price, making low-carbon investments more attractive and leading to a reduction in greenhouse gas emissions.

Additionally, the increased carbon price has also generated higher revenues for Member States, which can be used to support climate change mitigation and adaptation efforts. The EU ETS has undergone significant developments in recent years, particularly in relation to the auctioning of allowances, demonstrating its ability to respond to new policy objectives and financial requirements. A notable example of this agility is the ability to generate revenue for

specific purposes, such as improving energy efficiency and modernising energy systems, and to support key initiatives like the REPowerEU Regulation. The ability to swiftly redirect and allocate funds through the auctioning mechanism underscores the flexibility and responsiveness of the EU ETS, allowing it to play a pivotal role in supporting the EU's broader climate and energy policy goals.

8.7.5 Conclusion

The evaluation of the auctioning process reveals a largely successful system that has achieved its objectives of ensuring open, transparent, harmonised, and non-discriminatory allocation of emission allowances. The auctioning system has provided a consistent and fair approach to allocating allowances across the EU Member States, with auctions conducted in an open and transparent manner, and auction results published in a timely and accessible manner, providing sufficient information to participants and stakeholders. The system has also ensured equitable access to allowances for all eligible parties, including SMEs and smaller emitters, although some challenges remain, such as the concentration of auction participants and limited direct participation of SMEs.

Notably, the auctioning system has resulted in the allocation of planned amounts of allowances, with over 5 billion allowances auctioned between 2015 and 2023, generating more than 169 billion EUR in revenue. The system has prevented market manipulation and abusive practices, ensuring the integrity of the EU ETS. Furthermore, the auctioning system has been efficient in allocating allowances reducing the risk of over-allocation and windfall profits, and generating revenues for Member States, which can be used to support climate change mitigation and adaptation efforts.

To further enhance transparency, several minor improvements could be implemented. Providing a detailed publication information for reports would be beneficial. Additionally, harmonising the reports from the Common Auction Platform and the German auction platform would promote consistency and facilitate comparison. Furthermore, expanding the data presented to offer more insights into the participation of SMEs and small emitters in the primary market would be valuable, even though the current evaluation indicates that these entities are satisfied with the system and are procuring their allowances on the secondary market.

Overall, the evaluation concludes that the auctioning system has been a success in achieving its objectives, and its continued use is likely to play a crucial role in the EU's efforts to reduce greenhouse gas emissions and transition to a low-carbon economy.

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9 APPENDIX IV. OVERVIEW OF BENEFITS AND COSTS

Table 1: Overview of costs and benefits identified in the evaluation			
		Businesses	
		Quantitative	Comment
Compliance costs to directly regulated entities			
Direct compliance cost	Recurrent	Partly quantified/mostly qualitative	7. The value of allocation used for compliance that were not provided for free between 2018 and 2024 was estimated in Section 4.1.1.2.2 at approximately 238 billion EUR. 8. More exposure to carbon cost in Phase IV of the EU ETS due to higher prices and less free allocation. In Section 8.3.4.1, a quantitative analysis was undertaken to compare the volume of free allowances provided to industry in Phase III and IV for a selection of the most energy intensive product benchmarks. The outcome of this exercise was that the volume of free allowances has declined due to reforms to free allocation at the start of Phase IV but it is likely that the greater exposure to the carbon cost was at least partially offset by the fact that free allocation in Phase III was set based on ex-ante activity level that was higher than what actually over the 2013-20 time period. 9. The carbon cost per tonne of output was subsequently estimated in Section 8.3.4.1 for a selection of energy intensive product benchmarks. These estimated carbon costs ranged from 1 to 32 EUR/t or CWT. Industrial stakeholders estimated higher carbon costs (often citing higher specific emissions than the 2016/17 average values

			previously published by the Commission or assuming higher carbon prices) and these costs were then translated into a share of the overall product price. There was a consensus amongst industrial stakeholders that the carbon cost could not be passed through without impacting their competitiveness. Academic literature on evidence on cost pass through is limited but it does suggest that it may be more possible than implied by industrial stakeholders (refer to Section 8.3.4.2).

Table 1 continued.: Overview of costs and benefits identified in the evaluation			
		Public administration	
		Quantitative	Comment
Administrative and enforcement costs			
Enforcement costs	Recurrent	Not quantified	Costs linked to monitoring, reporting, verification, allocation and auctioning

Table 1 continued: Overview of costs and benefits identified in the evaluation			
		Businesses (regulated entities)	
		Quantitative	Comment

Provision of free allowances to lower compliance costs			
Direct benefit	Recurrent	Quantitative	The value of the free allocation provided between 2018 and 2024 was estimated in Section 4.1.1.2.2 at approximately **195 billion** EUR.
Provision of compensation for indirect costs			
Direct benefit	Recurrent	Quantitative	Section 8.3.4.1 outlines that total ICC payments has risen over time, from EUR 0.5bn for costs incurred in 2017, to **EUR 1.8bn for costs incurred in 2019, EUR 2.3 bn in 2020, EUR 3.1 bn in 2022 and EUR 5.5 bn in 2023**.
Reduced regulatory uncertainty			
Direct benefit	Recurrent	Qualitative	Predictable carbon pricing framework supports investment planning
Cost savings from simplification			
Direct benefit	One-off & Recurrent	Partly quantified	Exclusion of small emitters; targeted free allocation; simplified procedures. **SMEs:** Simplified requirements and exclusions reduce burden for smaller emitters. Installations with low emissions may submit simplified monitoring plans under 2018 Monitoring and Reporting Regulation. Exemption of very small installations from ETS surrendering obligation (ETS Directive Art 27a, introduced in 2018) See Section 4.1.1.2.3
Energy and carbon efficiency improvements			

Indirect benefit	Recurrent	Partly quantified	Econometric literature cited in the evaluation demonstrates improvements in industrial carbon efficiency e.g. evidence of stronger effect in sectors that lost carbon leakage status in Phase IV of ETS (from 2021). e.g. **0.5 tCO2e emission reduction per additional allowance purchased** (rather than allocated for free), and up to 10% increase in patents in ETS-covered sectors. See Section 4.1.1.1 & 4.1.1.3. However, the specific effect of 2018 intervention is difficult to disentangle from earlier and later developments.

Table 1 continued: Overview of costs and benefits identified in the evaluation			
	Businesses / citizens		
	Quantitative	Comment	
Stabilised carbon market			
Direct benefit	Recurrent	Quantitative	Benefit: the intervention removed the historic surplus of allowances, and increased market stability and confidence. EUA prices responded in 2019. Price behaviour since 2020 is consistent with market fundamentals as confirmed in ESMA reports and has been influenced by events (COVID-19, Russia invasion of Ukraine) and subsequent policy interventions (Fit for 55). See Section 4.1.2.1. Carbon prices permanently above <EUR 10 level seen in 2013-2017, up to EUR 25 in 2019. See Section 4.1.2.1.4.

			Annual TNAC communication increases availability of ETS data to market participants and stakeholders. See Section 4.1.2.2.3
Costs of understanding Market Stability Reserve			
Cost	One-off & recurrent	Qualitative	Uncertainty of auction volumes and complexity of price formation reported by some stakeholders, partially addressed by introduction of upper buffer in Fit for 55 ETS reform. See 4.1.2.2.2 & 4.1.2.3.4.

Table 1 continued: Overview of costs and benefits identified in the evaluation			
	Citizens / Public administration		
	Quantitative		Comment
Revenue from auctioning of allowances			
Direct benefit	Recurrent	Quantified	More targeted free allocation allows for increased auction revenues. Auctioning revenue between 2018 and 2024 estimated in Section 4.1.1.2.2 at around **EUR 196 billion** based upon EEX data. A large share of this revenue was distributed to public administrations. Part of this revenue was also distributed to the Innovation Fund and Modernisation Fund to support investments in low carbon technologies across industry.
Reduced administration related to provision of free allocation			

Direct benefit	Recurrent	Not quantified in monetary terms	It was assessed in Section 8.3.4.1 that the adoption of a single based indicator reduced the **number of sectors at the NACE 4-digit level covered on the 2021-30 carbon leakage list declined by around 65%** compared to the 2015-20 carbon leakage list.
Stable costs related to monitoring, reporting, verification and accreditation			
Direct benefit	Recurrent	Partially quantified	Stable MRVA costs to operators between ETS phase III and phase IV. With efficiency improvements (e.g. standard tools) largely offsetting increased requirements. See Section 4.1.1.2.3. Standard cost model estimate of **MRVA cost is 0.2-0.9 EUR/tCO2** for stationary installations and 0.2-04 EUR/tCO2 for aviation operators
More efficient use of free allocation			
Direct benefit	Recurrent	Partially quantified	Reduction in windfall profits due to reformed free allocation framework. See Section 4.1.1.2.2. Windfall profits from free allocation cost pass-through estimated at **EUR 26-46 billion** (2008-2019) in the literature but industrial stakeholders in contrast suggested their ability to pass through cost was very limited. Evidence suggests that the 2018 reform did not result yet in carbon leakage. See Section 4.1.1.1.3

Table 1 continued: Overview of costs and benefits identified in the evaluation			
		Citizens	
		Quantitative	Comment
Environmental benefit of greenhouse gas emissions reduction			
Direct and indirect benefit	Recurrent	Not quantified in monetary terms	Direct emissions reduction benefit from steeper linear reduction factor. Indirect benefits related to decarbonisation include air quality improvement, Increased energy efficiency and reduced fossil fuel dependency.
Reduced administration related to provision of free allocation			
Direct benefit	Recurrent	Qualitative judgement	Evidence suggests benefits outweigh costs, though not all impacts can be monetised

TABLE 2: Simplification and burden reduction (savings already achieved)

Report any simplification, burden reduction and cost savings **achieved already** by the intervention evaluated, including the points of comparison/ where available (e.g. REFIT savings predicted in the IA or other sources).

	Citizens/Consumers/Workers		Businesses		Administrations		[Other…] _ specify	
	Quantitative	Comment	Quantitative	Comment	Quantitative	Comment	Quantitative	Comment
Direct compliance cost savings (for example adjustment cost savings, administrative cost savings, savings from regulatory charges)								
One-off			Not quantified	Exclusion of very small emitters (below 2,500 tCO_2e per y ear).				
Enforcement cost savings (for example cost savings associated with activities linked to the implementation of an initiative such as monitoring, inspections, and adjudication/litigation)								
One-off					Not quantified	Targeted free allocation reduces the number of sub-sectors covered.		
Recurrent				MRVA simplifications achieved through amendments to Monitor and Reporting Regulation. See Section 5.2 & 10.4				

PART II: II Potential simplification and burden reduction (savings) Identify further potential simplification and savings **that could be achieved** with a view to make the initiative more effective and efficient without prejudice to its policy objectives[322].								
	Citizens/Consumers/Workers		Businesses		Administrations		[Other…] _ specify	
	Quantitative	Comment	Quantitative	Comment	Quantitative	Comment	Quantitative	Comment
Reforming conditionality for free allocation								
One-off			Up to 0.02 EUR/ton of CO_2-eq. could be saved if conditionality rules were not applied. See Annex 12, Section 1.4.1.2 of Impact Assessment	Although free allocation implies a cost burden, this has to be weighed against its potential benefit as a means of encouraging decarbonisation investment and allocating increasingly scarce free allowances as the emissions cap declines.	Not quantified	Further targeting of the carbon leakage list to simplify burden on the European Commission. See Impact Assessment preferred policy option for addressing carbon leakage.		
Simplification of the MSR								

[322] This assessment is without prejudice to a possible future Impact Assessment.

One-off / recurring				While simplification of the MSR appears to have advantages (e.g. transparency), a simpler MSR would not necessarily deliver a more stable carbon market.			

10 APPENDIX V. STAKEHOLDER CONSULTATION

See Annex 2 on Stakeholder Consultation